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November 22, 1928

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Engineering Problems of the Chicago Region

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Volume 101 NEW YORK, NOVEMBER 22, 1928 Number 21

A Profitable Undertaking

RESULTS of the first full year of operation of the Holland vehicular tunnels prove conclusively that the high traffic count of the first few weeks after they were opened was the result of something more than idle curiosity on the part of the traveling public. Traffic, particularly freight, continues in increasing amounts to flow through the twin tubes between New York and Jersey City. They have become an important traffic link between the east and west sides of the Hudson River. Financially, also, the tunnels are a success. When they were opened the toll rates were set at about the same as those on the cross-river ferries in order to make the tunnels of greatest public service without setting the rate so low as to put the ferries out of business. This was done because the commission realized that regardless of the unfairness of establishing rates much lower than those in effect on the ferries, the ferries must be permitted to hold enough traffic to keep them in business to take care of the growing traffic, which would far exceed the capacity of the tunnels were the ferries to shut down. When the tunnels were opened no one could say whether or not this policy would seriously limit their usefulness. That it has not done so is evident from the results of a year's operation. The balance sheet shows a substantial return after interest charges and operating costs have been paid. It yields nearly one and a half million dollars of capital repayment, and the present outlook is for even earlier amortization of the total cost than had been forecast.

The Engineering Laboratory

IT IS a distinct satisfaction to contemplate the dedication of a new engineering school laboratory, as that at Princeton last Thursday. The vital thinking of future generations of engineers is closely bound up with the kind of study that has its home in the laboratory. Not that the field, the construction job, will not always be a prime training ground; but its time necessarily comes later, when the student acquires that art which is to be his profession and which, while forming the capstone of technical science, must rest on this science as its foundation. The science, laid down in books, largely depends for its life and its inspirational power on those glimpses of the reality of nature's phenomena which the laboratory can give. The spirit and actual presence of research which should fill that laboratory endows the learner with a forward look, hope of new knowledge and new achievement, by which his efforts are given strength to progress. In every school the laboratory is sure to be a seed-bed of new ideas; most of all in an institution which stands as a citadel of scholastic thought. If engineering at Princeton is tinged with the academic flavor, it is not wholly the loser, for the academic contact can help it to acquire breadth of outlook; and at the same time the influence of the laboratory will always direct it in a true course, for the young engineer who learns the virtue of discovery of fact and proof of law by test is in little danger of straying. Because of this we need not fear for the present that, as some have claimed, there will be too many engineering laboratories, even though they should come to absorb and replace the lecture room.

Educational Objectives

WHILE thinking of the laboratory's function of keeping the engineer in close correlation with present facts, it is well that we keep in mind also the rapidly growing demand upon the engineer for adventurous imagination, for untrammeled breadth of view and readiness to disregard the limits of precedent. Dean Dexter Kimball, of Cornell, set forth this demand most impressively in an address at the Princeton dedication. Quite in line with what we have tried to suggest more than once, he urged upon his hearers that if the engineer does not realize how vastly tomorrow may be ahead of today he is not prepared for his share in tomorrow's work. A generation that saw the birth of the steam turbine and soon saw it grow beyond all forecast, to units of more than one hundred thousand kilowatts, must be ready to dream of possible half-million or million kilowatt units of tomorrow. If yesterday it learned that bridges of half-mile span are mere paper fancies, it may tomorrow see a mile-long span become a reality. If it builds up the structure of the world's mechanical industries on a doctrine of low labor cost, it must not be surprised if a Taylor by trial and a Ford by practice disprove this doctrine and initiate an industrial revolution. The established engineering education tends in a measure toward building up relief in limits established by past practice, but something more is needed to equip the student of today for coming tasks. The necessary combination of great boldness with a severely practical caution, it is true, is a native gift, and a rare one; yet in so far as it can be stimulated by the college the educators have a plainly marked duty. Some of them are conscious of it.

Sound Policy

THE MEETING last week of the American Institute of Steel Construction was in large measure a confirmation of the organization's expressed purpose of extending the use of structural steel in construction work. With commendable discernment such live subjects as flame cutting, welding, steel joists, fireproofing and airplane hangar construction were given a place on the program. This immediate recognition of new possibilities for structural steel in construction work and of the important controversial problems that have arisen from its past use constitutes sound practice. No less sound is the Institute's newly announced program of studying the problems of buying and selling with the hope of evolving a code of ethics or trade practices. Such a program has possibilities. One of them, better relations with the producers, was auspiciously introduced by having Charles M.

Schwab repeat to the fabricators his remarks on open steel prices given previously before the organization of the steelmakers and discussed in these columns last week. A satisfactory solution of the steel pricing question, which is the *sine qua non* of buying and selling, would constitute a powerful lever for lifting the whole steel industry out of its satisfaction with antiquated merchandising. The steel fabricators' program lends hope that some progress in this direction will soon be made.

Use Figures With Caution

OBSERVATION is coming to the aid of calculation in regard to road needs and road capacities. Thus, a traffic survey in the Cleveland region indicates, according to the Bureau of Public Roads, that a road reaches maximum capacity at a traffic speed of 20 to 25 miles per hour, while higher speeds reduce the capacity. A. N. Johnson, taking all safety factors into consideration, has calculated a lower figure—15 miles per hour. Basing its consideration on safe braking distance, the Pennsylvania State Highway Department has concluded that 22 miles per hour will produce the greatest volume of traffic flow. All these figures, uncertain as they are, are most interesting, and should improve our road thinking. But it is proper to point out that they have little bearing on the question of actual and desirable road speeds or on the setting of speed limits on rural roads. None of the speeds mentioned is as high as those commonly found on the open road. Most sections of road, moreover, never carry a capacity load, being limited by local throttling points, so that capacity conditions are not a speed criterion. The practical application of speed-capacity observations, therefore, is to the local regulation of heavily taxed trunk sections, and here they may prove of great value as a mathematical yardstick to be applied to questions of widening, removal of obstructions and similar traffic improvements.

The Mysterious Fire

HOWEVER much science has advanced since the early days of history, those vast and unknown founts of energy that are contained down in Earth's structure remain as profound a mystery as they were to the tribes of the patriarchs. The appearance of a new geyser in the Yellowstone group a few weeks ago and the more recent terrifying outbreaks of lava from Etna's side are equally unfathomed as to their origin and meaning. Such occurrences seem rare phenomena indeed, with no relation to human existence and its problems. Even though the earth's surface in every quarter of the globe is thickly crusted with former lava flows, some known to be very old, a few apparently quite recent, yet we think of them all as belonging far back in the geologic ages and wholly remote from today's life except as dead records of former happenings. But when we read of a railway line overwhelmed and a modern bridge destroyed by the crawling incandescent stream of present-day lava, we realize that volcanic activity is a real and continuing phenomenon. Evidently stores of energy of tremendous magnitude are back of its manifestations, and, at least sometimes, this energy is sharply concentrated. We have little to fear of its power for destruction, on the evidence of thousands of years during which outbreaks have occurred only at few well-marked points. May there be a future possibility of putting that energy to useful service? Science and engineering have so far given no answer to this question. Should one be discovered, however, it may change human ways most thoroughly.

Getting Results

WHAT little regional engineering has been done in this country has been confined, for the most part, to the preparation of plans; little of it has reached a point of practical application. There are, however, a few outstanding examples of definite accomplishments. The Chicago region is one of them. In this issue W. W. De Berard describes what is proposed for that region and what may be set down as definite accomplishments as a result of organized efforts. The noteworthy feature of the Chicago situation is the magnitude and definiteness of the regional engineering problems existing there. The feature of the Chicago Regional Planning Association's work is that it has directed its efforts toward shaping present undertakings to fit in with future needs. Comprehensive plans of broad vision have been made, but they have never been deemed so inflexible as not to be susceptible of modification to suit immediate needs. Early it was realized that much could be accomplished by co-operation and by subordinating the regional organization in order that local bodies might get full credit for local accomplishments. The wisdom of this attitude is clearly indicated by the definite accomplishments of the planning association. It should be an inspiration to others looking for some method of making their planning effective.

When Shall Drawbridges Open?

QUESTIONS as to the relative rights of water-borne traffic over land traffic continue to be of great concern at certain points throughout the country. At Chicago, where closing of the drawbridges over the Chicago River has been in effect during morning and evening rush hours for a number of years, day-time delays are becoming so serious that a proposal to close the bridges during the entire business day is being considered. At New York the War Department continues to decline to grant any partial relief by rush-hour closing of drawbridges, though some relief has been obtained in so far as the railways are concerned through the construction of high-level crossings by the Central Railroad of New Jersey and by the Lackawanna Railroad. On other railways and on the highways the problem is still critical.

Outside of the larger centers the same problem is not less serious. At Providence, R. I., an agitation is on foot to have the draw in the Washington bridge over the Seekonk River closed during morning and evening hours. Here also highway traffic is tied up by frequent openings of the bridge while traffic is moving in or out of the city. Conditions are to be further complicated at this point by the work of rebuilding the bridge, which will extend over a period of two years. At Seattle, where highway traffic has been seriously inconvenienced at water crossings, a committee upon which maritime, industrial, commercial and civic interests are represented has been appointed to study the situation.

Except at Chicago the problem never has been subjected to scientific analysis. The traffic on any river or channel has a certain time value which can be computed and set over against the similar value for the time lost on a highway or railway due to the opening of a draw span. The two values can be determined, at least roughly, and preference given to the class of traffic which stands to

lose the more through delays. So far as we know, only one such analysis has been made. More frequently the decisions appear to have been made simply upon the basis of a showing by the shipping interests that they might be put to some inconvenience or actual delay, regardless of how unimportant the delays were in relation to the delays caused on the railway or highway involved. At Chicago it has been proposed that the all-day closing provision be applied to all except large vessels engaged in interstate commerce. In this way it is hoped to avoid serious delay to important river traffic. Such a provision might well be applied at other places.

The chief difficulty in the whole situation lies in the fact that the War Department, which is the chief advocate of the waterways of the country, is set up as the judge to decide upon whether or not drawbridges shall be closed during certain hours. Regardless of how impartial the army engineers endeavor to be, it is but natural for them to give special consideration to the pleadings of those who favor keeping the waterways open. The subject will not be given the broad consideration it should receive until the special pleadings are heard by a tribunal upon which both sides are adequately represented.

New Vision Required

DEVOTION to routine characterized the deliberations of the state highway officials at their annual meeting last week in Chicago. The strictly technical alignment of the standing committee through which chiefly the organization functions is in a measure the explanation. The committees on design, construction, bridges, materials, accounting and a half-score more of technical subjects presented capable reports exhibiting in several instances an immense amount of labor. They had performed during 1928, as in past years, all the duties within their assignments and had performed them capably.

That there were no reports carrying highway thinking ahead to coming problems and visioning the future of public-roads service is the fault of the committee set-up, which is founded on the conception of the highway official as a builder and maintainer of roads and not as a planner and promoter of transportation service. The remedy lies with the association. It consists in directing committee activities into the broader field. This action need not contemplate any abandonment of present committee subjects. Indeed, it would be decidedly unwise to curtail in any way the study of roadbuilding technique. Design of road structure, road construction and road maintenance remain major tasks of the highway official. With less than 20 per cent of the state-system mileage paved and less than 47 per cent surfaced with gravel or a higher-type construction, there remains need of design, construction and maintenance studies for many coming years. When all this is entered into the appraisal of the work to be done by highway officials, however, they have not fulfilled their obligations as public-roads administrators. They have still the pressing duty of perfecting the highway as a tool of transportation.

Today, except in very isolated instances, the road is not perfect even in the simple requirements of physical structure. Its broader purpose of creating, increasing, promoting, conveniencing and pleasuring travel and of giving unhampered flow to traffic has been scarcely appraised as an objective. This is the creative task now ahead of highway officials. It is not a substitute task, it is an extra task. By realignment of the working organization of the association it can be carried forward.

Personalizing Engineering

AS AN example of how to personalize most excellently an intricate engineering project, Judge Harris Dickson's story of "Old Man River" in the Nov. 3 issue of the *Saturday Evening Post* is to be recommended. The story tells how the river went on a spree last year and misbehaved so badly that patient, amiable Uncle Sam had finally to take notice and put him back in his place. By and large, the author sticks close to facts, and accepts without question Uncle's plan as laid down by the army engineers. He repeats some of the propaganda arguments of the valley residents, such as the fact that the water comes from 31 states, that it is Uncle's duty to control the river on account of post-road obligations, and that full protection must be given from superfloods; but these are negligible features of his presentation of the subject.

The author explains in easy, understandable terms the problem of providing by auxiliary channels for more water than the leveed river can carry. He accepts the reason for fuse-plug levees, localized crevasses. He explains that the present levees are as high as feasible, for if built higher they would sink into their mud foundations. He admits that too much natural storage at the mouths of the tributaries and in certain basins has been taken from the river. In most picturesque and effective language he portrays the occurrence of sand boils, a fascinating subject.

Apparently, he implicitly believes in the method of protecting Cairo by means of the New Madrid setback; here he ignores the wails of protest of the east-state Missourians against the scheme, though he goes to much trouble, even to the extent of quoting a letter from Uncle Sam, to allay the fears of the Boeuf Basin objectors. He says that in so large an enterprise it is inevitable that someone's toes are going to be stepped on—which is obvious and undeniable. Applying this point of view to the selection of the fuse-plug levee plan in place of the controlled spillway method, he very properly points out that under our system of government some supreme authority must make decisions, weighing profits against losses, and "Uncle Sam has chosen the fuse plug." Whether that is enough reason for engineers is another story—even though present data are too few to support any far-reaching decision.

Judge Dickson gives further currency to the age-old notion that the river must have curves and that if straightened it will automatically regulate itself to such a rate of flow as the banks will stand. Such beliefs as these are at last beginning to be questioned by real students of river hydraulics, both within the valley and outside; they may have to give way to newer views, as did the levees-only theory so long adhered to. Another ancient notion is the idea that the Mississippi is a law unto itself and that while hydraulic engineers may know how to handle the Rhone, the Yang-tse or the Nile, they have quite a different problem in the eccentricities of the Mississippi. This dogma, too, may be outlived perhaps.

Altogether, Judge Dickson has given the layman a most readable account of one of the country's greatest present problems. Engineers are indebted to him for an adequate digest and description of one of their largest tasks, for general public reading. It is of no consequence that he has included controversial details; he deals with them fairly. The great thing that the engineer may learn from the article is how to personalize the presentation of a technical matter.

Engineering Problems of the Chicago Region and Their Solution

Non-Official Organization Undertook the Work With Some Money Aid—Co-operative Methods Proved Effective—Results Are Promoting Orderly Development

By W. W. De Berard
Associate Editor, Engineering News-Record

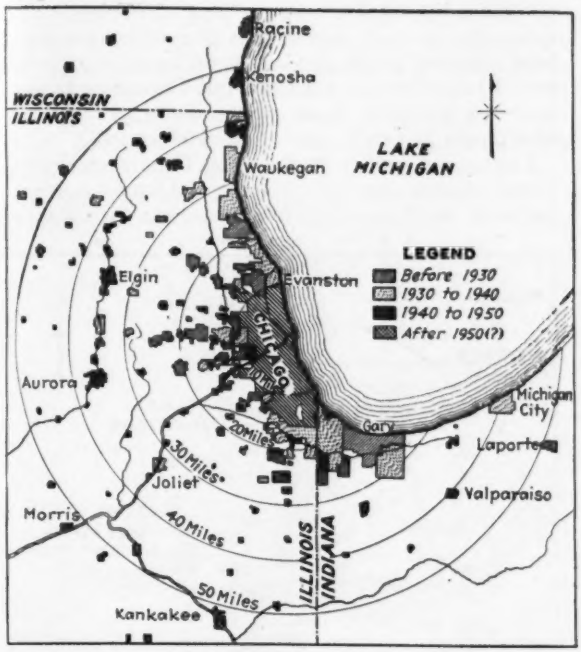
FOR the orderly development of a region surrounding and making up a great metropolitan area like that at the foot of Lake Michigan a comprehensive co-ordinated consideration of all the changing factors of civilization is desirable. Obviously this ideal study cannot be carried out with the money usually available. In consequence only the more pressing and salient features of public and private improvement have been taken up. Engineering problems of a regional nature, methods of attack from both an engineering and organization standpoint, form the substance of this article.

Chicago, it will be recalled, nearly 30 years ago set the pace in city planning when in 1909 it produced the Burnham plan and established its City Plan Commission. The Wacker Manual, a primer of the Chicago plan, was adopted for study in the city schools in 1912 and a Housing and Town Planning Exhibition was held in 1913. Thus early were the citizens of this region educated to the advantages and desirability of expert and far-seeing planning for civic improvement.

These early operations of the City Planning Commission have been continuously supported and officially recognized in projecting new improvements down to the present. Actual benefits are visible in such things as the Michigan Ave. double-deck bridge, opening to the north the most congested trafficway in the city; the Union Station development; the two-level Wacker Drive, replacing the unsightly wholesale market along the north side of the Loop district; the widening of Twelfth St. to the south of the Loop, and the removal of many other similar constructions. All of these are engineering projects and correct some early-day error, due largely to lack of vision. The expanding list of engineering problems covering a wider area than the limits of Chicago, together with the early education within the city, made comparatively easy the formation of an organization of

©Chicago Aerial Survey Co.

CLOSE TO THE HEART OF A GREAT CITY MUST COME TRANSPORTATION TERMINAL FACILITIES
Straightening the Chicago River will open three new streets to the south of the Loop business district. To maintain its supremacy the central business district must make itself easily accessible to the outlying region.



FORECAST OF DATE WHEN 1920 POPULATION OF VARIOUS MUNICIPALITIES WILL BE DOUBLED

Growth of near-by suburbs is 65 per cent faster than that of Chicago.

regional scope to extend the benefits of co-ordinated engineering into the outer city areas. The City Planning Commission is an official body financed by the Chicago City Council and obviously could not extend its jurisdiction, studies or activities beyond the city limits. Anyway, its primary activity necessarily has been corrective of former errors, while regional thinking must perforce be based on somewhat different concepts, mainly with undeveloped territory.

Problems of the Region

What are some of these urgent pressing problems that require extra-city and multi-city treatment?

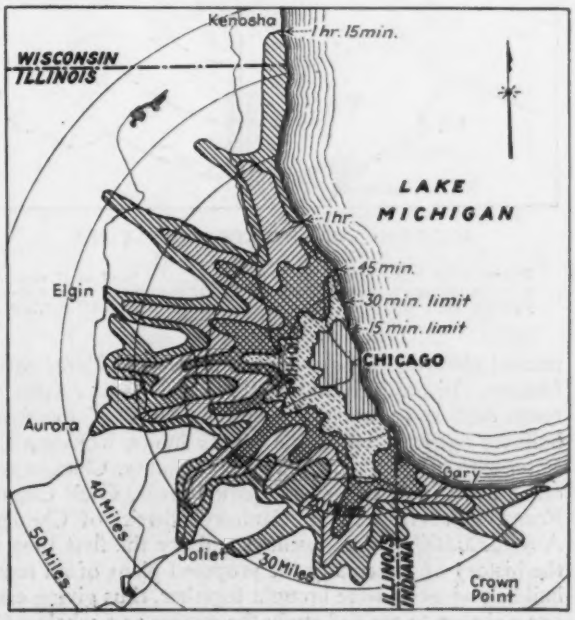
Sanitary District First Regional Project—Early forcing itself on the region was the sanitation problem. The common supply for drinking water was polluted by the city and the surrounding municipalities. If ever combined action was needed on a regional basis, the depopulating typhoid death rates in the Chicago region during the early nineties, just before the World's Fair, furnished the incentive. The formation of the Sanitary District of Chicago, composed now of Chicago and 49 other municipalities, resulted. From the health standpoint the result has been one of the greatest triumphs the sanitary engineer has yet achieved. Water-borne typhoid has disappeared. Ever before the people of the region, therefore, is the successful example of its first essay into regional engineering.

Forest Preserves—Next perhaps in importance, but not so decidedly engineering, was the authorization to a Forest Preserve Commission to buy within Cook County a forest preserve system of 35,000 acres. All of this acreage had been acquired except about 10 per cent when the Chicago Regional Planning Association stepped in and induced the commissioners to form a citizens' advisory committee to suggest final purchases and lay out a comprehensive plan.

With the association's staff such a plan has been developed, consisting primarily of a continuous parkway to connect all of the individual tracts by intervening strips of land at least 660 ft. wide. Special developments of landscaping, recreation facilities and plantings are also involved. Recommendations for the acquirement of these connecting strips have been followed consistently, and while not yet complete, the citizen of Chicago will soon be able to boast of an outer belt of forest preserves encircling practically the entire present closely built-up portion of the region.

Highways—Probably the most urgent regional engineering problem of today for Chicago or any other great city arises from the greatly increased use of the automobile. The driver of a car does not care what the type of pavement he drives over may be if only it is smooth; he does not care for the cities he must pass through, if the route is wide, straight and continuous. The counties and municipalities of the region planned and built roads largely to suit local needs. The states more nearly than any other agency have stuck to through route alignments. The cities perhaps are the worst offenders in not providing their share of master highways to serve the region's traffic as a whole. Getting together the key men of these various units of highway and street development has been of the greatest assistance in the solution of this transportation problem. The Regional Association has acted as a clearing house for the accomplishment of that purpose. It has co-ordinated the plans of contiguous governing bodies and brought them together into one map. Then it has laid the plans with all their glaring defects before the officials in charge. Suggestions to make routes across boundaries meet and become a part of the master plan have required little further advocacy. So long as most of the alignment of the main trafficked roads in the Chicago region continues to be selected on a basis of ultimate expected traffic, without benefit of present-day traffic counts, it is of the utmost value to have engineers select the routes.

Cook County last year voted favorably on a $15,000,000 bond issue for greatly extending its highways, widen-

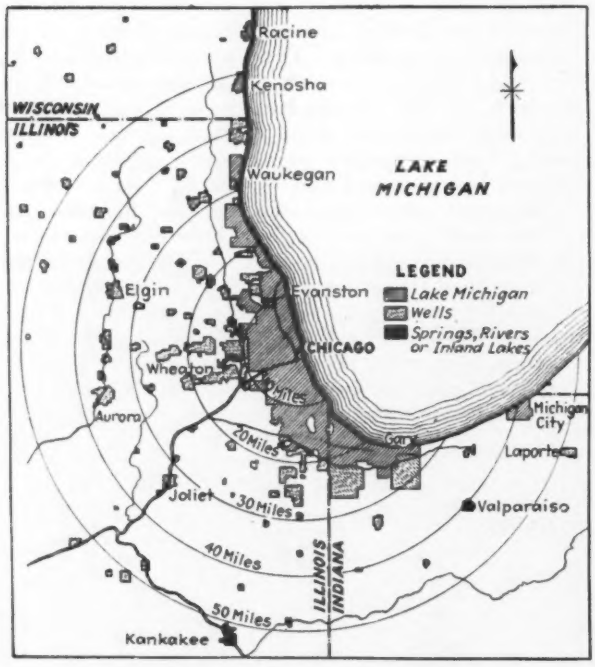


RAILWAY COMMUTATION TIME AT FIFTEEN-MINUTE INTERVALS

The average morning and evening one-way suburban train times from the terminal are illustrated for both steam and electric service.

ing its most congested existing roads and filling in numerous links in the piecemeal system of previous expenditures. The original proponents of the issues were insistent only on widening 300 miles of existing county roads at an estimated cost of $50,000 per mile without regard to the more urgent need of filling in links and making extensions or to the greater service to be obtained from parallel roads of ordinary width. Grade separations, finally included, were not thought of at first. The part played by the association indicates the method and flexibility of its procedure.

Developing the Plan—Anton J. Cermak, president of the Board of Cook County Commissioners, is a great believer in the value of citizens' advisory committees to work out policy problems. In consequence such a body was formed with the president and manager of the association as chairman and secretary, respectively, of a large advisory committee representing all parts of the county and all of the official and commercial interests involved. The association staff worked up a plan and estimate, submitted it to the advisory committee, received its suggestions for revisions and additions and resubmitted the

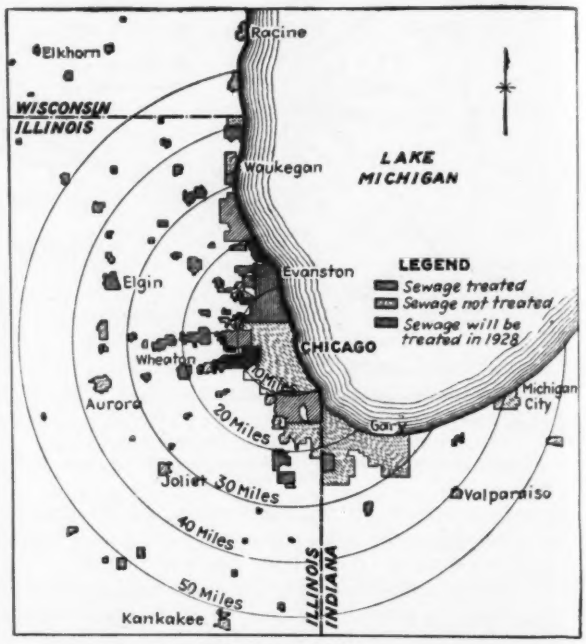


MAIN SOURCES OF WATER SUPPLY ARE THE LAKE AND WELLS

Every year more cities get lake water, the land well supplies receding, some as much as 12 ft. per year. A metropolitan lake water system stretching farther and farther into the interior is inevitable.

revised plans and estimates until it was considered satisfactory. In the plan was included the whole system of roads built and proposed to be built by all of the road-building agencies within the county limits, including the state, with and without federal aid, county, Chicago and other municipalities, several park boards, Cook County Forest Preserves and the Sanitary District of Chicago. A $32,000,000 project resulted and for the first time in the history of the county the proposed plans of all road-building agencies were brought together, thus giving each one a chance to see and study the system as a whole. Of more importance, each official learned where in the completed system his portion fitted. An ideal system cannot be located by this means, and "political" mileage crept in, no doubt, but the 75 to 80 per cent of efficiently placed roads was so much better than that which usually had been obtained under previous bond issues that indorsement by the Chicago Association of Commerce and other civic organizations came whole-heartedly. An overwhelmingly favorable vote at election resulted.

During the studies on the Cook County program adjacent counties were kept in mind and later on programs for them were developed in conjunction with their offi-



EXTENT OF SEWAGE TREATMENT IN THE REGION

Rapid progress is being made toward the treatment of sewage of all the municipalities in the region. That is one of the main objectives of the Regional Planning Association.

cials. Some of these will ripen into bond issue projects. The state is taking some of the proposed mileage, and current revenues will care for others.

Perhaps the most spectacular regional highway engineering feature has been the launching by the association of the Three-State 200-ft. Boulevard project extending 165 miles from Milwaukee directly south through the western suburbs of Chicago and then passing around the foot of Lake Michigan south of Gary and the other Indiana industrial centers, on east to Michigan City. Some day Michigan, it is hoped, will extend it to Detroit. Another branch extends directly east from Chesterton, Ind., to La Porte. As a result of hundreds of meetings with officials and citizens along the route, 80 per cent of the right-of-way has been obtained either by easement or dedication.

Ultimately the association will produce and recommend a master plan of superhighways 4 to 6 miles apart, but immediate developments have been coming so fast since the organization was founded that work has been largely confined to the present, but with the ultimate always in mind.

Realtor the Original Planner—The realtor, as the real estate agent and subdivider now likes to call himself, is the original city planner. On him largely rests the sins of irregular street patterns, jogs, impossible curves, dead ends and narrow streets. Forever afterward the engineer in all of his plans for pavements, lights, sewers, water, electricity and telephone lines must cope with this

hampering irregularity. Underground conduits cause many of the surface defects in pavements, and the errors and deficient designs which are responsible originate in the suburbs, often beyond the confines of any city. The county and state highway departments are interested and control drainage problems. The state board of health often comes in only after a sewage nuisance starts. The large city, when annexation takes place, finds sewers too small and grades too flat. There arose then a demand

TEN SANITARY DISTRICTS COMBINED COVER 64 MUNICIPALITIES

The Sanitary District of Chicago, which alone includes 53 municipalities, was the first regional activity. Limits of former Fox River Conservancy District indicated.

for some control over the subdivider in the way he plotted his land and over his engineers and those of the public utilities using the under surface for conduits.

Here are regional problems that require going back to the seat of the trouble. An outstanding piece of work has been accomplished by the association in bringing together a committee of realtors who produced a set of rules for subdividers which would eliminate many of the previous errors. Of principal engineering interest are the requirements in street dedications of 100-ft. right-of-way on section-line streets and all designated arterial routes, 80 ft. on half-section lines and 66 ft. on all others. For alleys 20 ft. is the width. No dead ends are allowed and alignment must meet that of adjoining property. The principal public benefit is the framework of 100- and 80-ft. thoroughfares which will eventuate. A total of no less than 180 miles of 100-ft. right-of-way and 210 miles of 80-ft. right-of-way has already been dedicated. Seven counties and seventeen cities have adopted the rules.

Zoning—Zoning has become so active in the Chicago region that constant demands are made on the association for assistance in drawing up new ordinances and in administering those already in existence. A zoning engineer is employed who has prepared a charted summary of ordinances now in effect and a model ordinance. The association feels it is largely responsible for the adoption of zoning ordinances in eight towns and activity toward that end in more than a dozen other towns. The association will expound the principles of zoning and its administration, but does not draw ordinances or zone property, both, it feels, being professional work for which a fee should be demanded.

Regional engineering is affected by zoning, since the future character of a given area is predetermined thereby, and the utilities of water supply, gas, electricity, sewers and transportation can be provided for in advance by the engineer with some degree of assurance that the trunk line capacities are in proportion to the expected financial returns.

Conduit Code—The association attacked the underground conduit problem through a committee on drainage, sanitation and water supply. A code allocating the underground space in streets and highways and laying down minimum requirements was developed and has been adopted as standard practice by all of the interests represented on the committee. The membership consisted of nine private engineers, seven state and city engineers, one federal engineer and one public utility engineer. The code applies only to unincorporated areas in Illinois. The Wisconsin State Board of Health already has one covering water and sewer installations.

Water Supply—Eventually much of the Chicago region must get its water from Lake Michigan. The groundwater supply used by many of the cities back from the lake is being depleted at a rapid rate, falling in some cases as much as 12 ft. per year. Already Chicago furnishes water to a number of bordering cities and, in fact, it is legally required to do so by the provisions of the sanitary district law. Chicago meters but a small percentage of its consumers; in consequence it has a hard time to furnish an adequate supply within its own borders, to say nothing of caring for those beyond its limits. A metropolitan system for the region therefore is inevitable,

AIRCRAFT LANDING FIELDS AND PAVED HIGHWAYS

Without paved highways the great advantage of airplane speed is largely nullified at the terminals.

but its early consideration became urgent because of the agitation of private water companies proposing to serve a portion only of the suburbs of Chicago to the west and north. Taking up the subject as a regional problem, the association staff developed a tentative comprehensive plan for a metropolitan water district. The two water companies have recently consolidated and the activity may again be renewed on a more comprehensive basis, but logically the city of Chicago must furnish the core of the system.

In furtherance of drainage facilities, limits of sanitary and conservancy districts to cover practically the whole region were laid out. Assistance given to local officials was followed up by appearance in courts, where the limits were set during the legal formation of the districts.

Special studies were carried out in the Calumet industrial area with a view to stirring up the many municipalities in Indiana discharging wastes into the lake directly or indirectly to the point of caring for the disposal of their sewage either jointly or severally. The Calumet district sewage is the one remaining direct menace to Chicago's water supply. While the filtration for Chicago will remove the health hazard, the phenol tastes and odors due to industrial wastes are so strong that only diversion or sewage treatment will eliminate them. Not much progress has been made, because of the high costs to the corporations and of jealousies of officials who do not care to go into a comprehensive sanitary district organization in which their identity and political influence would be submerged.

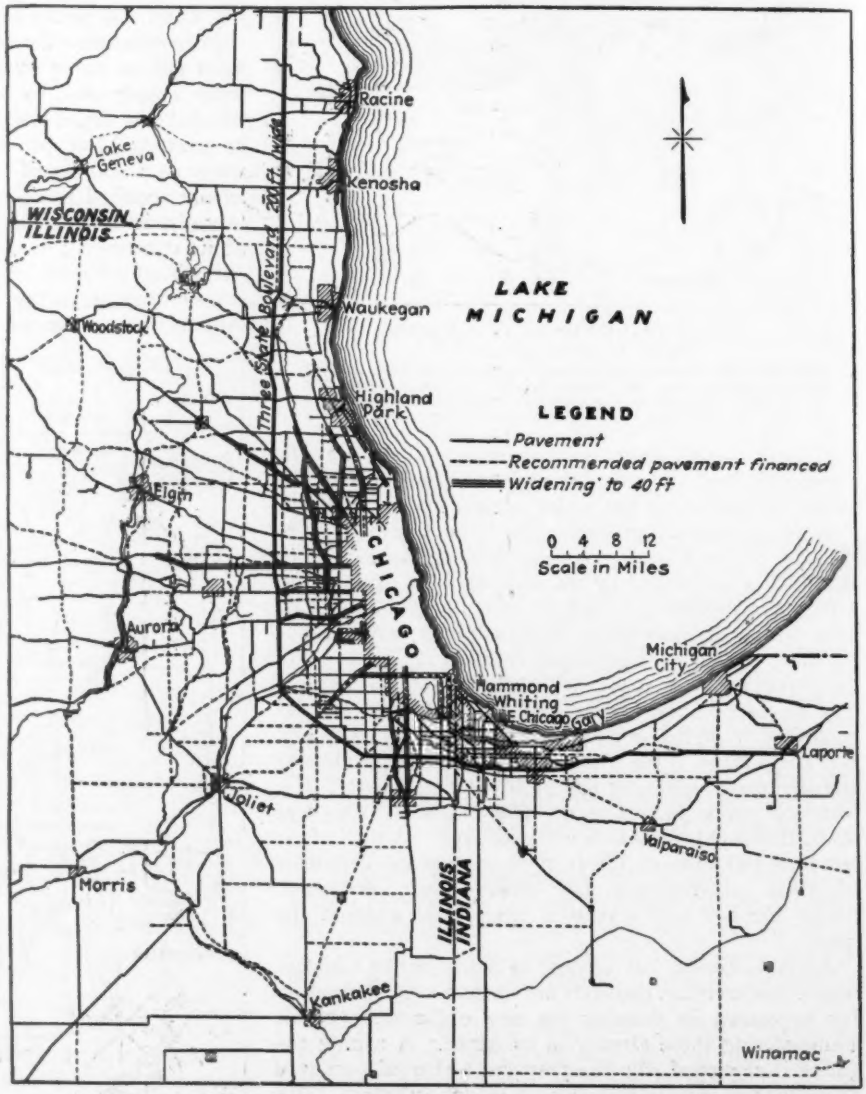
Organization — Initiation of much of the regional engineering in the Chicago district heads up in the Regional Planning Association, which is an independent, nonpartisan organization operating roughly in the commuting area, a radius of 50 miles from central Chicago. In the region are parts of three states, 7,800 square miles of land, fifteen counties, 230 townships, 250 cities, towns and villages, 400 school districts, 60 park districts, twelve sanitary districts and many drainage districts.

Policies—Two main general policies have been held to rigidly for the last three years. First, that of merging the many city, village, county and state plans into a composite whole, and second, that of making independent investigations of planning principles so that these many plans may be founded upon scientific bases.

The first policy recognizes the fact that the area which the association aims to serve is governed by many independent municipal bodies and that the association is organized to help them carry out their plans in harmony with one another. No attempt has been made to tell them what to do, but rather to extend an offer of help to each in making its park, subdivision, zoning, street, highway, sewage-treatment plans, which are going ahead anyway, adequate, well balanced and harmonious with those of the neighboring municipal bodies.

Rather than draw plans for the region as a whole or any part of it, the association has undertaken to promote, among the officials who have the power to act, certain sound practices in planning and building the many separate but tangible units which together make up the complicated whole.

The second main policy, that of making special studies of a technical nature on which to base the many plans, takes the direction of research or investigation into subjects which present daily problems to municipal, county

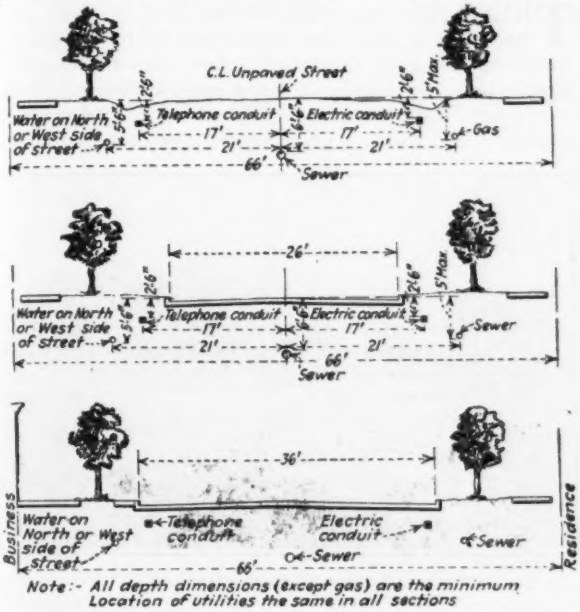


EXISTING AND RECOMMENDED PAVEMENTS, ALL OF WHICH HAVE BEEN FINANCED EXCEPT THE THREE-STATE BOULEVARD

Right of way 200 ft. wide, has been obtained for 80 per cent of the Three-State Boulevard. The recommended new pavements and widening of old ones are largely provided for by a $15,000,000 bond issue in Cook County, the State of Illinois $100,000,000 bond issue and others by current revenues.

or state officials. Particularly to be noted are regulations controlling the subdivision of land into lots, recommended widths of rights-of-way and pavements, summaries of zoning ordinances in effect in the region, a recommended ratio of parks to population, a recommended ratio of business frontage to population, recommended street and highway traffic signs, recommendations on the location of underground conduits in the streets and highways and other principles and practices which are generally approved as sound practice.

Ultimately there will result a compilation of master plans for the various construction activities which must



ALLOCATION OF UNDERGROUND SPACE FOR CONDUITS

accompany the work of the many authorities. These individual plans will be founded on sufficiently similar bases to make them fit together in an orderly fashion.

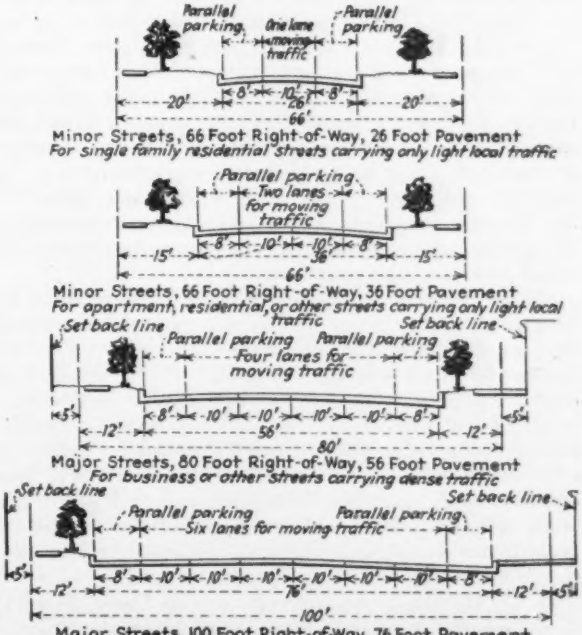
Financing the Association—Without funds the association accomplished little or nothing the first two years beyond interesting a small group of individuals and educating them to the necessity of a paid staff. Under a reorganization three years ago an executive secretary and manager was appointed and a $75,000 budget developed. Percentages as follows were allocated to various subjects: administration, 1½; airways, 2; fine arts, 1½; drainage, sanitation and water supply, 15; general surveys, 12; health, 1; highways, 30; legislation, 3; parks and forests, 12; public utilities, 2; rail transportation, 3; subdivisions and zoning, 12; water transportation, 3; meetings and miscellaneous, 2.

Due to the lack of funds for such an enormous job, the association has attempted to enlist the co-operation of other organizations in handling parts of the problem. In consequence such research bodies as the Local Community Research Committee of the University of Chicago have been responsible for regional base maps, analyses of geographical and geological background of the region, history of population, trends and forecasts of expected population, study of major industries and their requirements. Financial assistance has been rendered by such organizations as the Commonwealth Club and City Club. By arrangement with the Institute for Research in Land Economics of Northwestern University a study of the size of retail business districts was made by a graduate student under the direction of the association. This proved of such value that it was greatly added to by the staff until 41 cities have been investigated, establishing the fact that on the average 100 persons support 50 ft. of retail business frontage.

General Procedure—The general methods of procedure followed by the association has been to form standing committees for each major subject, the direction going back to a board of directors made up of representatives of counties, municipalities, industries and other interests. Personnel of the committees is made up of public officials and other association members of experience, all of whom serve voluntarily. Details for the committees are handled by the staff, which is organized to confer with and help local authorities directly, with or without reference to committees.

The staff of eleven initiates projects to place before public authorities as well as handles in some way the many suggestions brought in by officials or interested citizens. It is responsible for the program and policy which it places before the board of directors or the various committees, which are largely independent.

Eight subjects of immediate importance have been studied by as many committees: general surveys, subdivision plats and zoning highways, airways, parks and forests, public health, legislation, drainage, sanitation and



WIDTHS OF PAVEMENTS RECOMMENDED BY THE REGIONAL PLANNING ASSOCIATION

water supplies. Not all committees have been equally active or effective, but some work has been done by the staff on all of these subjects.

Personnel Selection—So important is the proper selection of personnel of the active committees considered that as an example the connections of the 26 members of the committee on highways are given: Six private firms are represented by a vice-president of the Consumers Company (material), a vice-president of the Central Trust Company (bank), sales engineer of the Western Wheel Scraper Company (equipment), engineer of the Lehigh Stone Company (material), vice-president of the Mack International Motor Truck Cor-

poration (equipment), secretary of the Brownell Improvement Company (material). Three public utilities are represented by the vice-president of the Chicago & Joliet Electric Railway Company (interurban to the south), engineer of the North Shore Electric Railway (interurban to the north), engineer of the Chicago Surface Lines (local street railway). The three public association members are two officials of the Illinois State Automobile Association and one official of the North Township Good Roads Committee, Lake County, Ind. The largest group is that of the public officials, who are closest to the problem and will have the most to do with carrying out any project proposed. Fourteen public official bodies are represented by the superintendents of highways in Cook, Kane, Lake and Will counties in Illinois; district county engineer of Lake County, Ind.; the chief engineer of streets, Chicago Board of Local Improvements; the district engineer and chief highway engineer, Illinois Division of Highways; the structural engineer, Sanitary District of Chicago; the chief engineer, Indiana State Highway Commission; the district engineer, U. S. Bureau of Public Roads; the divisional engineer, Wisconsin Highway Commission; the divisional director, Chicago Plan Commission.

It is apparent that work initiated, sponsored and recommended by the committee is not unknown to the official who must really put it before his constituency and see it through, for he has already had a part in its development. Likely enough the plan is his own, changed only in minor details to harmonize and fit it into similar plans of his neighbors. The staff does not stop with putting proposed plans before the committee but has carried them out into the district affected and appeared at meetings along with the local representatives. The meetings are almost never called by the association but are sponsored by local officials who know something of the project and request the association to present the broad aspects of the situation.

Accomplishments—Perhaps it is too early to count up results of the activities of the association, but already they number too many to bear recital in detail. Further, the co-operative, stimulative nature of the work done does not permit a very definite evaluation of its effectiveness. Every project the association proposes must depend on some other body to carry it through. Collection of information and maps, compilations of statistics, their digestion and exposition into chart and slide form for public education are definite enough, but real results are bond issues voted, rights-of-way dedicated, forest preserves bought and sanitary districts formed.

D. H. Burnham, an architect, son of Daniel Hudson Burnham, father of the Chicago plan, heads the Chicago Regional Planning Association. B. F. Affleck, president, Universal Portland Cement Company, is the treasurer. Robert H. Kingery is the executive secretary and manager, F. W. Penfield is manager of parks and forest department, H. R. Olson is highway engineer, J. M. Albers subdivision and zoning engineer and E. L. Bailey chief draftsman. The writer, on leave of absence for a year from *Engineering News-Record*, was chief engineer up to last October.

Double-Tracking Missouri Pacific R.R.

Pipe culverts on the second-track work of the Missouri Pacific Railroad are of corrugated iron and not concrete pipe as noted in *Engineering News-Record* of Oct. 18, p. 578.

Ingenious Method Used to Float Bridge Spans to Site

Two Three-Drum Hoists on Barge Run Cables Through Pile Dolphins and Control Movement of Spans of Arkansas River Bridge

By C. T. Nitteberg
Engineer, Bureau of Public Roads, District No. 6, Fort Worth, Tex.

THE floating into place of six 214½-ft. steel truss spans for a state and federal aid bridge across the Arkansas River at Dardanelle, Ark., has been accomplished by an extremely effective method devised by the contractor's superintendent. The flood hazard made it necessary to dispense with as much falsework as possible

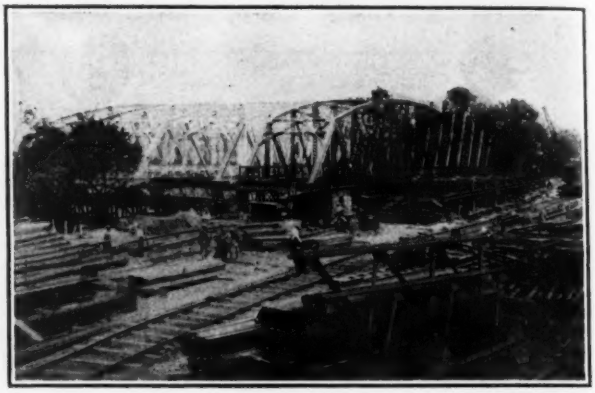


FIG. 1—TRUSSES UNDER CONSTRUCTION

and the contractor elected to erect six of the trusses of the bridge on shore and float them into place.

The bridge when completed will consist of seven 214½-ft. steel truss spans, one 362-ft. swing span, two 60-ft. reinforced-concrete deck-girder approach spans at the north end and one 40-ft. reinforced-concrete deck girder span at the southern end. The structure is designed to carry a 20-ft. roadway with one 5-ft. sidewalk.

The first step in the operation was the construction of a loading dock of sufficient length to hold six spans. It was located about 400 ft. upstream from the bridge site and consisted of two timber trestle runways extending far enough out into the river to permit the entrance

FIG. 2—TRANSFERRING A TRUSS FROM LOADING DOCK FALSEWORK TO BARGES

Barge shown is being pumped out in order to raise the span from the timber trestle runway of the loading dock.

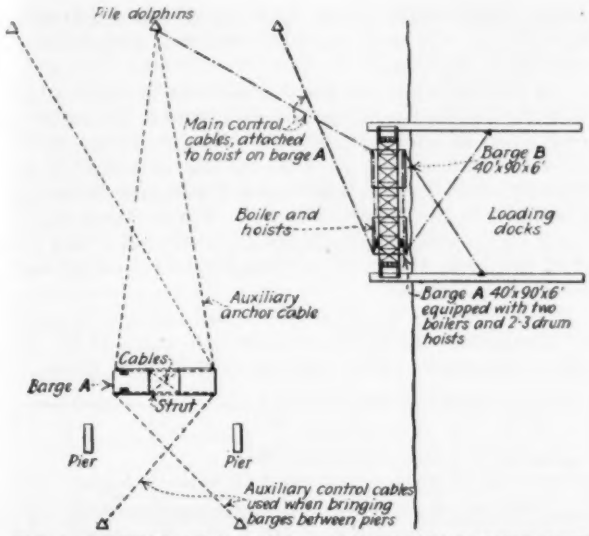


FIG. 3—METHOD OF MOVING SPANS FROM LOADING DOCK TO BRIDGE SITE

of two barges. All trusses were fabricated on this single set of falsework as shown in Fig. 1.

Two barges were required to float the spans from the loading dock to the bridge site. Each of these, 40 ft. wide by 90 ft. long by 6 ft. deep, was built and launched by the contractor at the site of the work. A three-bent trestle was constructed on each barge for supporting the truss spans at the second, third and fourth panel points on each end. The barges, by partial scuttling, were lowered in position beneath the trusses on the loading dock falsework. Then, as the water was pumped from the barge, the truss was raised clear of the dock as shown in Fig. 2.

The most interesting feature of the construction was the complete control of the barges from aboard the barges themselves, with cables attached to three eight-pile dolphins driven at appropriate intervals across the river upstream from the loading dock. The barge used as the control unit was equipped with two boilers and two three-drum hoists. One hoist operated the two main control cables, and the second hoist carried auxiliary control cables which were attached to two anchorages below the bridge site and were used in conjunction with the main control cables to bring the trusses into exactly the proper location over the piers.

The two main control cables, as shown in Fig. 3, were crossed and attached to the two inshore dolphins at the beginning of the flotation work. As the barges supporting the span moved out into the river, an anchorage cable was also attached to the intermediate dolphin and the cross-cables were changed over to the two offshore dolphins. The barges were thus under perfect control at all times and no difficulty was experienced in maneuvering the span into the correct position where the barges were again partly scuttled and the trusses lowered to timber blocking placed on the piers. The barges were then pumped free of water and returned to the loading dock for another truss. The timber blocking on the piers was made necessary by the unforeseen high water in the river at the time of flotation.

The entire operation was accomplished without difficulty and in rapid time, the first span being placed in position on June 11 and the remainder from June 30 to July 4, inclusive. It required 1½ hours to load the span and pump out the barges, 1½ hours to float the span into place, one hour to set the blocking on the piers, 1½ hours to partly scuttle the barges and bring the span to rest on the blocking, and two hours to bring the barges back to the loading dock.

The Dardanelle bridge is being built by the Arkansas State Highway Commission at an estimated cost of $588,000. The finished structure will replace a pontoon bridge on which tolls are now being collected. The bridge was designed under the direction of N. B. Garver, bridge engineer for the state highway department, and is being built under the supervision of R. C. Gibson, assistant bridge engineer in charge of the western division and C. A. Dunn, resident engineer, assisted by R. E. Hiles. The contract is held by the Lakeside Bridge & Steel Company, the work being carried out under the personal direction of S. C. Coddington, president; S. C. Waller, superintendent, and M. W. Kehart, engineer.

Welded Railway Crossing Costs

Recently figures were published showing the cost of welding railway crossing frogs on the electrified suburban lines of London, England. The cost of the work, including current, electrodes and the labor of the welder, grinder and flagman, is placed at about $20, as compared with a cost of $75 for a new frog of ordinary rail steel; adding the labor cost for taking out the old and putting in the new frog brings the total up to $125.

FIG. 4—SPAN BEING BROUGHT TO REST ON PIER
Barges with falsework bents lowered by scuttling. At left, spans on loading dock trestles.

Enlargement of Union Station at St. Louis, Mo.

Ten New Tracks Give Total of 42 Platform Tracks —Street Changes—New Express and Coach Yard Facilities

ALREADY one of the largest passenger stations in the world, the Union Station at St. Louis, Mo., is to have ten new tracks added to the original 32 tracks, materially increasing its trackage and area. Besides the additional tracks, there will be an entire reconstruction of the baggage and express facilities and a rearrangement of coach storage and cleaning yards. The construction work is now well under way.

This station has probably the heaviest traffic of any large terminal, except for the two New York stations with their immense suburban traffic. At St. Louis the total number of trains in and out daily averages 260 under normal conditions and 45 trains per hour at periods of heavy traffic, exclusive of light engine and empty train movements. Of these totals the suburban trains average only about 4 per cent.

At this terminal the main tracks are at right angles with the station tracks and are connected to the latter by two wyes, as shown by Fig. 1. In the old layout the express buildings and yard are on the west side of the approach and have a long curved building practically parallel with the curve of the Y. Farther west was a coach yard, with nineteen diagonal stub tracks, and this yard has been rebuilt with fifteen tracks parallel with those of the station.

On its west side the passenger station has been bounded by Twentieth St., which formed the entrance to the express facilities. This stub end of the street, however, is not a direct continuation of Twentieth St., but at Market St., on which the station fronts, it is offset about 146 ft. to the east. By the new arrangement this part of the street will be abandoned and given to the terminal company. In turn the company has acquired and deeded to the city the land required for a direct extension of Twentieth St. as far as Eugenia St. and has paved this extension with granite blocks. From this street there will be an inclined approach to a passenger subway leading under the south end of the station, with a similar approach or ramp at Eighteenth St. The additional passenger station tracks will occupy the entire space between the present west station tracks and the new Twentieth St. In this way the station building and concourse can be extended 146 ft. across the ends of the new tracks. The extension will accommodate the baggage room.

As the new station tracks will connect with the main

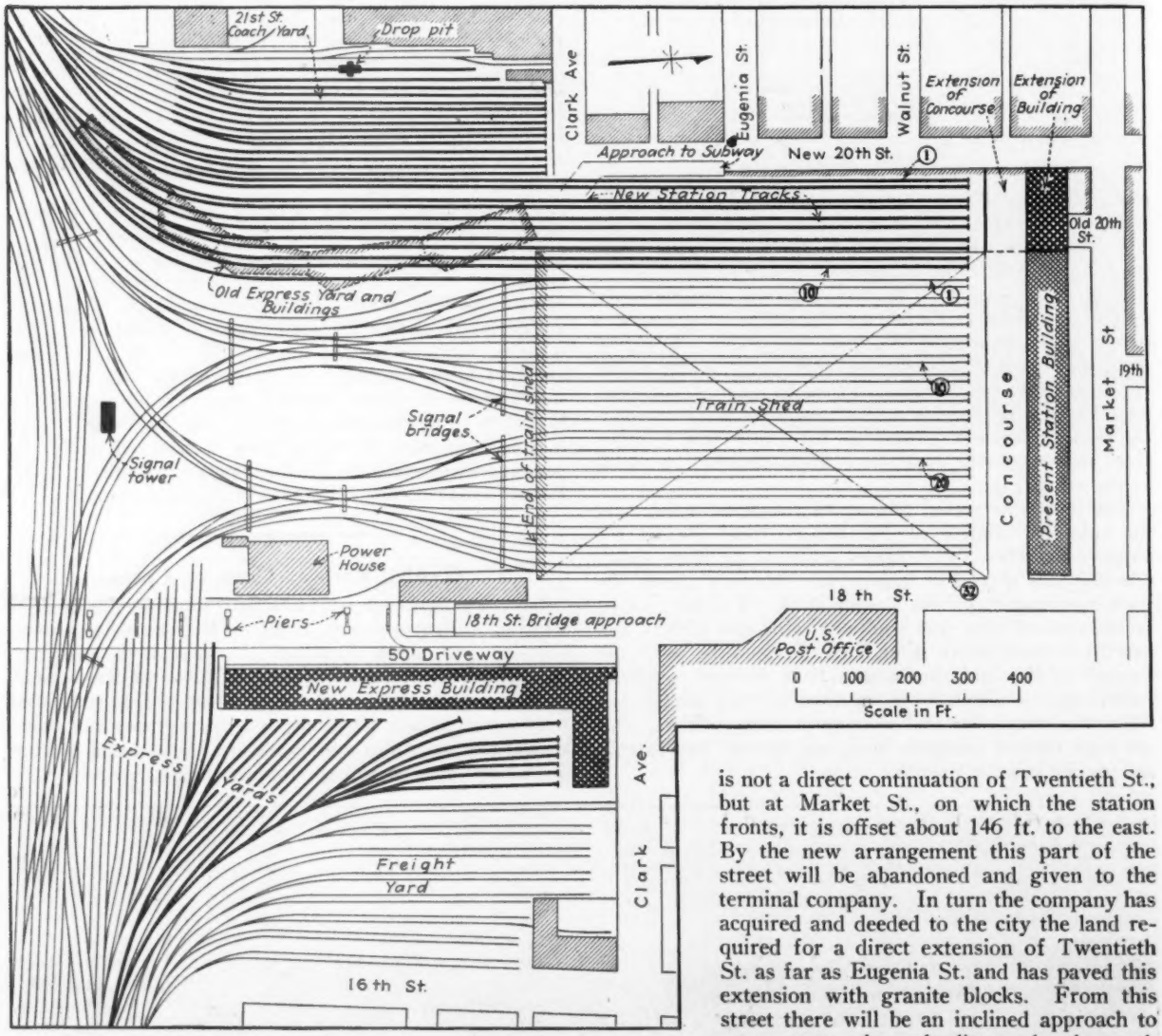


FIG. 1—ALTERATIONS TO UNION STATION, ST. LOUIS, MO.

tracks independently of the present Y approach, they will be much longer than the present tracks. Thus the present tracks and platforms average about 800 ft. in length, whereas the new ones will average about 1,200 ft., with curves of 15 deg. at the outer ends. These new tracks will be in pairs spaced alternately 12 ft. and 24 ft. c. to c., and with concrete platforms 14 ft. wide. A lofty steel-truss trainshed spans the present station, but separate canopy roofs of steel and concrete will be used on the new platforms, the tracks being partly uncovered.

Since the extension of the station on the west side is important, since the heavy business makes it necessary to make movements of empty trains to and from the station on scheduled times.

Negotiations for the passenger station improvements have been in progress for some years between the terminal company and the city, but have now been brought to a satisfactory conclusion, and the city will vacate the present stretch of Twentieth St. south of Market St. A contract for the construction work has been let to Dwight P. Robinson & Company, New York. These extensive improvement and alterations were planned under

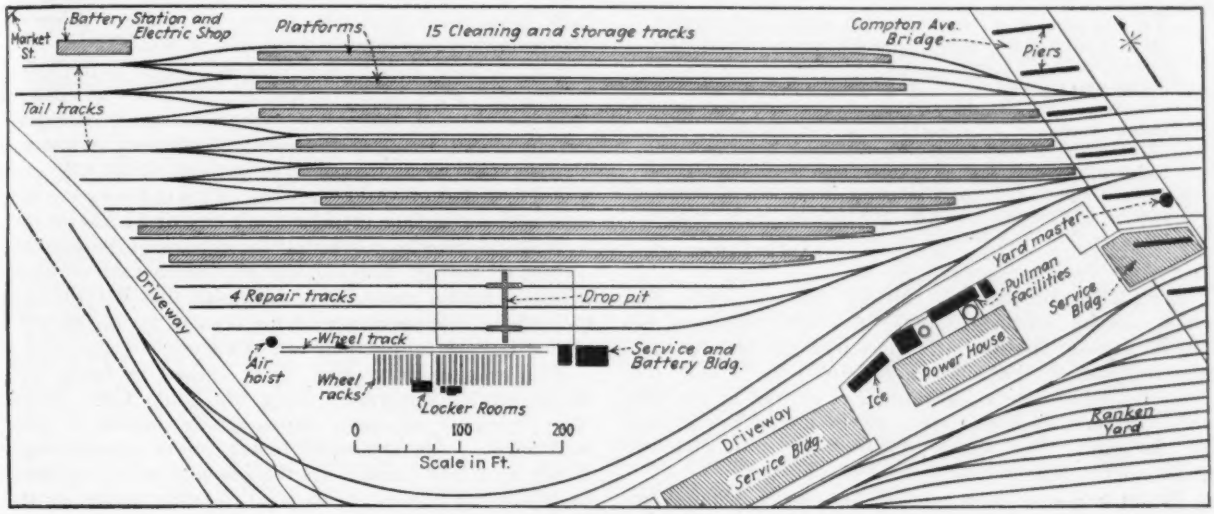


FIG. 2—COACH YARD WITH TAIL TRACK CONNECTIONS

wipes out the express facilities entirely, a new location for these had to be provided. They must of necessity be close to the station, and the best available site was on the east side, where a large coach yard existed. This site has been cleared to make room for a two-story express building 700x70 ft., parallel with the approach to the Eighteenth St. highway bridge and separated from it by a 50-ft. driveway. A four-story L-extension or wing, 220x60 ft., will front on Clark Ave., and about eighteen stub tracks will be at the rear of the building.

In turn, the abandoned coach-yard facilities have been replaced, and as there was no available site adjacent to the station, land was used at Market St. and Ranken Ave., about 1½ miles west from the station. Here a group of fifteen coach tracks and four repair tracks was laid before interfering with the old coach yard. The coach tracks are 600 to 1,100 ft. long, spaced 13 and 15 ft. c. to c. and accommodating about 127 passenger cars. This new yard is furnished with modern facilities for coach cleaning and repairs. The platforms between the coach tracks are of concrete, 6 ft. wide.

An unusual feature introduced in the track layout of this new coach yard (Fig. 2) is that while it has only stub tracks, several of these are connected at the far end by crossovers, leaving tail tracks of sufficient length to hold an engine and tender. In ordinary stub-yard practice, an engine taking its train into the coach yard must have the engine detached and run around to the rear end so as to push the cars into the yard. With the crossover arrangement and with certain coach tracks unoccupied, the engine can pull its train directly into the yard, and can then be switched to another track to pass out or to push another train into the Union Station. When this can be done there is a saving in time, which

the direction of Henry Miller, president Terminal Railroad Association of St. Louis; H. J. Pfeifer, chief engineer; and O. F. Harting, assistant chief engineer. The total cost, inclusive of the additional land and new coach yard, will be about $5,000,000.

Indiana City Held Liable for Sewage Pollution

The city of Frankfort, Ind., has been held liable for damages resulting from the pollution of Prairie Creek by the sewage of that city. Suit was brought against the city by Jay D. Slipher. Both the Circuit Court and the Appellate Court of Indiana held that the city was liable for damages, the opinion of the latter having been rendered on June 19. The Appellate Court overruled the city's contention (1) that it may pollute the stream so long as it is done without negligence; (2) that creation of a public nuisance was not proved; (3) that the plaintiff had relief offered to him which he had not exercised, apparently meaning recourse to the State Board of Health to exercise its authority to prevent stream pollution. In the course of its opinion the Appellate Court said, "It is daily becoming more and more apparent that the sewage in the streams is a real menace to the public health, and it is not a necessity, because it can be otherwise provided for, with practicability and assured safety to the public health." The court also denied that there was any "rule of necessity" for pollution in this case. A slightly fuller abstract of the decision is given in *Public Health Reports*, U. S. Public Health Service, Washington, D. C., for Sept. 22, based on an article in the monthly bulletin of the Indiana State Board of Health for June, 1928.

Settling Tanks Lighten Burden on Tucson Sewage Farm

Circular Tanks With Mechanical Sludge Scrapers, Separate Sludge Digestion Tanks and Sludge-Drying Beds Recently Completed

By F. M. Veatch
Of Black & Veatch, Consulting Engineers, Kansas City, Mo.

Tucson is one of the comparatively few American cities that has disposed of its sewage by broad irrigation. As has been the experience elsewhere at home and abroad, Tucson has been faced with the alternative of abandoning its sewage farm or providing means of pretreatment of the sewage. The latter has been adopted. Clarification only is used for the present, but provision has been made for more complete treatment later on, if needed, in which case it is thought that the clarification works might serve as the basis for the activated-sludge process.
—Editor.

After approximately thirteen years of fairly successful sewage-disposal by broad irrigation, the city of Tucson, Ariz., has built settling tanks to remove part of the solid matter from the sewage and thereby reduce the odor nuisances, which in the past have occasionally been caused by the use of raw sewage on the land. For sludge disposal, separate digestion tanks and sludge-drying beds are provided.

Broad irrigation as a method of sewage disposal has seemingly fallen into poor repute in this country, but it must be said for the Tucson sewage farm that, from a sanitary standpoint, it has been nearly successful, the single well-founded objection to it having been that, from time to time, the sewage flow has exceeded the amount desirable for irrigation, so that some raw sewage has been allowed to reach the Santa Cruz River, which, for a considerable part of the year, is a dry watercourse.

From an esthetic standpoint the operation of this project has not been entirely successful, due partly to its location in a fairly thickly settled valley (see Fig. 1), but principally to lax operation in keeping the ditches clean. Numerous complaints of odors have been made by residents of the vicinity and by travelers who use the road which skirts the farm on the southwest, but there has been no continual nuisance. A careful survey of the farm indicates that the odors from it may be traced to sludge deposits in poorly maintained irrigation ditches, unburied screenings from the bar screen at the head of the irrigation system and improperly prepared fields which have allowed some ponding of sewage.

From a financial standpoint the operation of the sewage farm has shown a small profit for the entire period of its operation. In the calculation of this profit, however, fixed charges on the investment by the city were not included, and therefore, as an agricultural project alone, this farm has not been successful. Considered as a method of sewage disposal, with cropping as a by-product, the farm has been successful, since the sewage of the city has been very satisfactorily disposed of at very low total cost.

The sewage farm consists of 750 acres, of which 550 acres are so located as to be irrigable and 250 acres have been cleared, leveled and prepared for cultivation. The land was bought piecemeal over a fourteen-year period at a cost of $48,600. With improvements, which have been made with city funds, the present value of the farm is conservatively estimated at $62,000.

For the year ended June 30, 1926, crops to the value of $16,944 were harvested on the 250 acres of cleared land (see balance sheet, Table I). Deducting operating expenses, this leaves a surplus of $2,020, but if interest charges (which at 5½ per cent amount to $3,421) are added, a deficit of $1,400 appears. This is a very low annual cost for sewage disposal for a city of 32,500 people.

With the view to correcting the defects in the existing system of sewage disposal, the city had a careful study of the situation made, with the result that it concluded to continue the operation of the sewage farm, but with settled sewage rather than raw sewage.

The sewage farm (Fig. 1) is located in fairly well developed rural territory along the Santa Cruz River. The proximity of dairy farms, which dispose of milk in Tucson, a famous health resort, offers a psychologic if not an actual reason for the elimination of nuisance in this district, and the lack of diluting water in the Santa Cruz River precludes anything but complete sewage treatment.

Three types of sewage-disposal plants were studied

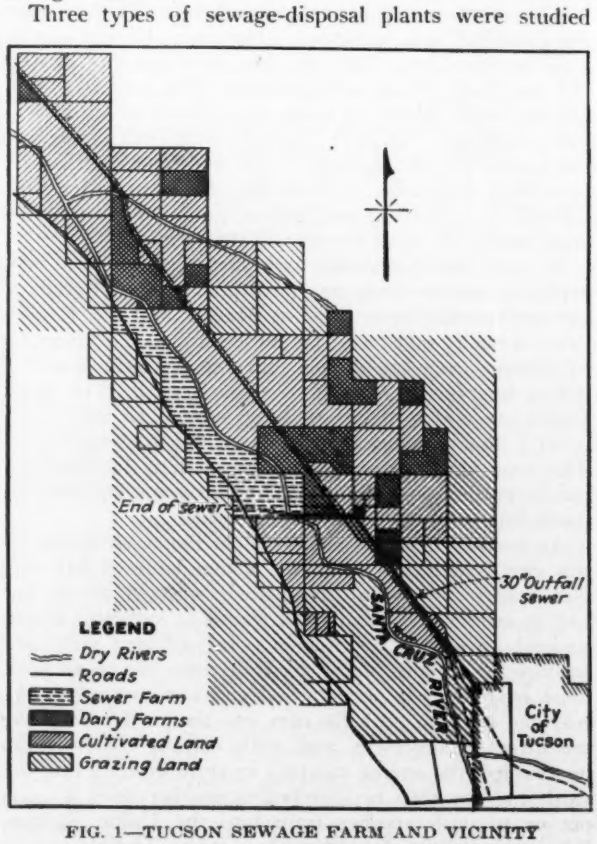


FIG. 1—TUCSON SEWAGE FARM AND VICINITY
Note proximity to dairy farms and cultivated land.

TABLE I—BALANCE SHEET FOR TUCSON SEWAGE FARM, YEAR ENDED JUNE 30, 1926

Operation:			
Labor	$6,442		
Seed	612		
Repairs and supplies	1,567		
Shop and stable expense*	2,611		
Total operation		$11,222	
Maintenance:			
Labor	932		
Material	1,077		
Implement replacement	1,693		
Total maintenance		3,702	
Total cost of maintenance and operation			$14,924.59
Farm Earnings:			
Crops sold	14,341		
Harvested crops on hand (at current prices)	2,603		
Total earnings			16,944.00
Gross earnings			2,020.00

*A portion of the total city bill for garage, stable and shop expense is charged to the farm.

TABLE II—COMPARATIVE COSTS OF THREE TYPES OF SEWAGE-DISPOSAL PLANTS FOR TUCSON, ARIZ.

	Imhoff Tank and Sprinkling Filters	Activated-Sludge	Clarification and Sludge Digestion
Construction cost	$279,500	$226,800	$73,000
Cost of additional land	.....	.....	30,000
Yearly operation cost inclusive of maintenance and fixed charges	30,400	43,100	9,865
Estimated yearly loss on operation of sewage farm	.....	.....	4,700
Total per capita yearly cost of sewage disposal based on estimated population of 40,000 in 1932	0.76	1.13	0.36

TABLE III—SEWAGE FLOW AND LAND REQUIRED FOR BROAD IRRIGATION AT TUCSON

		Acres of Land Required			
Year	Sewage Flow, M.G.D.	Crop Land to Be Irrigated at 0.4 In. Per Day*	Allowance of 20 Per Cent for Land on Which Water Is Not Needed	Allowance for Wasting Sewage at 0.8 In. Per Day	Total Acreage Required
1927	2.00	187	39	93	319
1932	3.00	276	55	107	468
1937	3.56	327	63	163	595

*In peak seasons the sewage flow will be increased by pumping well water.

as to cost and suitability. Their relative economy, based on treating the sewage from 45,700 persons, is shown in Table II.

A study of the irrigation problem at the farm brought out the fact that additional acreage of irrigable land will be required for efficient cropping, and that it will be necessary to keep a certain amount of land uncultivated, for use when all the sewage is not required by the crops. The areas required and the expected sewage-flow are shown in Table III.

A careful examination of the soil upon which raw sewage had been used for nearly fourteen years showed no indication of putrefaction or sourness, and, since the irrigation rates used in calculating the required acreages have been exceeded in the past, there is no doubt of the fact that this method of disposal is practical here.

Since the operating costs here given include fixed charges based on retirement of the entire indebtedness in twenty years, it is possible that the sewage farm will eventually show an actual profit. It must be remembered that this project is located in a warm, dry climate, on pervious soil, and that a similar project located, say, in Missouri or Kansas would not have a chance for success.

In view of the fact that future development of the land around the sewage farm may make necessary more complete treatment of the sewage than is provided by sedimentation before it is used for irrigation, the proposed plant was designed as the preliminary part of an activated-sludge plant, as shown in Fig. 2.

The plant, which was completed in April, 1928, includes bar screens, two settling tanks, a pump house, four sludge-digestion tanks and ten sludge-drying beds. Water for use at the plant and for an additional supply for irrigation is available from a small system to be constructed with the sewage-works consisting of a well, pump house, elevated tank and necessary pipe lines, having a capacity of 0.85 m.g.d.

The bar screens have 1¾-in. openings. The screenings may be raked onto a drainage slab for partial drying before burial. Provision is made for scum removal by suitable drain lines.

Sewage enters the settling tanks through two submerged intakes which lead from the opposite sides of the screen chamber, passes to the center of each tank and is discharged downward through elbows. These lines are valved so that the tanks may be operated singly or in parallel. The tanks are 30 ft. in diameter, with an average water depth of 10 ft., and have a combined capacity of about 0.104 m.g., equal to the maximum

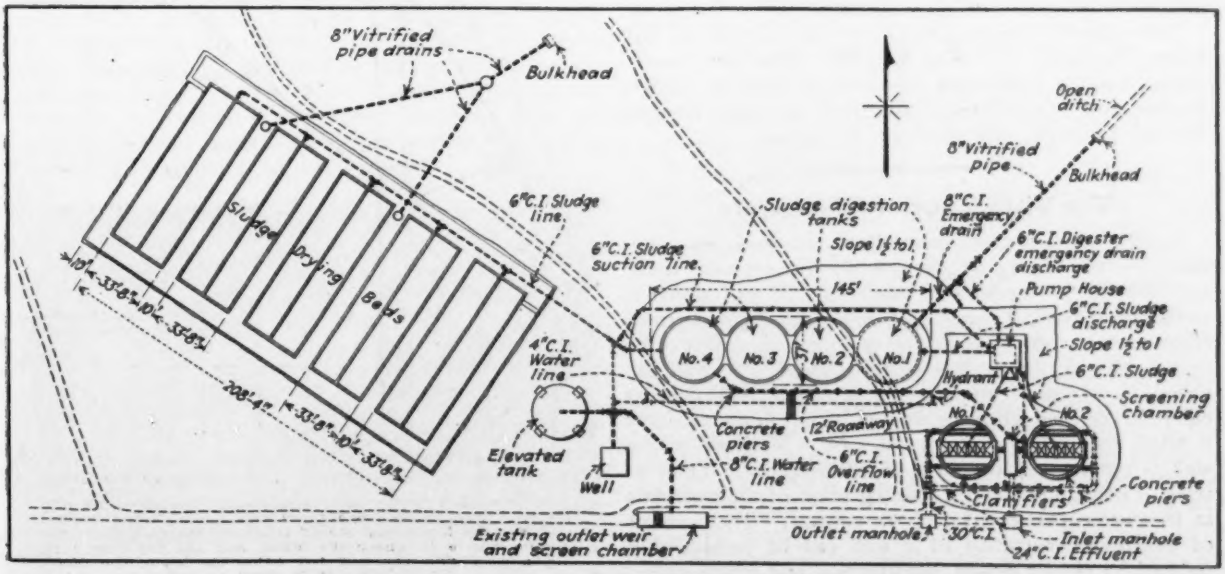


FIG. 2—GENERAL LAYOUT OF TUCSON SETTLING TANKS AND SLUDGE-TREATMENT WORKS

sewage flow for twenty minutes. The effluent from each settling tank is drawn off over two weirs with a combined length of 92 ft. into troughs which discharge into the existing sewer, leading to the irrigation system at the point where raw sewage is now discharged. This relatively small settling capacity has been employed here, since the removal of only the grosser solids is contemplated.

Each tank is provided with Dorr revolving scrapers which push the sludge to a central 6-in. sludge pipe leading to a sludge sump adjacent to the pump house. A motor-driven centrifugal pump lifts the sludge to the first of four sludge-digestion tanks, each of which is 35 ft. in diameter and 25 ft. deep. The tanks are operated in series. A total capacity of 95,000 cu.ft., or 2 cu.ft. per capita for the estimated population of 47,500, is provided. The first tank is covered with a concrete roof set below the water level to prevent the scum from drying out, but the other tanks are open. The overflow from the digestion tank will be returned to the screen chamber for resettling. Provision has been made in the piping layout for circulation of the sludge through the sludge pump and for the conditioning of the sludge by means of lime treatment, should this prove desirable.

Digested sludge is removed through an 8-in. eduction pipe, located in the fourth or last tank, and is delivered to one of ten sludge-beds, 16 ft. wide by 100 ft. long. The total area of the beds is 16,000 sq.ft., an allowance of about ⅓ sq.ft. per capita. The beds are composed of 6 in. of sand on 9 to 15 in. of gravel. Each bed is underdrained by three lines of 6-in. tile, laid with open joints. The drainage from the beds is discharged on the surface of the ground near the plant. All sludge lines are of cast-iron pipe so connected that they can be flushed out by water from the elevated tank. The relatively low allowance for sludge-bed area in this plant is due to the high temperature, low humidity and extremely low precipitation which characterize the Tucson climate.

To provide water for operation of the plant and for additional irrigation during the seasons of peak demand, a 20-in. well has been sunk 75 ft. into the gravel. This well is equipped with a 600-g.p.m. vertical, motor-driven, deep-well centrifugal pump, delivering water to a 35,000-gal. steel tank on a 50-ft. steel tower.

The plant was constructed by Frank Parrott, of Salt Lake City, Utah, for about $73,000. Plans and specifications for the work were prepared by Black & Veatch, Kansas City, Mo. Construction work was supervised by George T. Grove, city engineer of Tucson.

Wet Walls Cause of Efflorescence

Soluble salts, present generally in all masonry materials, are the source of efflorescence on exterior walls, says the U. S. Bureau of Standards. A wall which is perfectly dry at all times will never develop noticeable efflorescence, regardless of the quantity of soluble salts in the masonry, according to the bureau. A wall exposed to excessive moisture penetration will develop efflorescence even when the amount of salt in the masonry is much less than is usually the case. Moisture in the wall is the immediate cause of efflorescence. Efflorescence is often attended by disintegration of the materials in the walls, particularly of the mortar. The amount of moisture penetration of a wall can be considerably reduced by proper design, construction and maintenance.

Truss-Braced Circular Cofferdam Used in Constructing Intake

Carefully Framed Timber Struts Allow Free Access to Center of Open Caisson for Building Concrete Shaft

By L. J. Jordan
Consulting Engineer, Charlotte, N. C.

In the construction of a raw water intake to the pumping plant of the Lancaster Cotton Mills, Lancaster, S. C., it was important that no cofferdam bracing pass through the concrete walls of the intake structure. Accordingly a steel sheet pile circular cofferdam was designed with trussed-timber ring bracing to clear the exterior walls of the structure to be built.

The intake, 12x14 ft. inside dimensions with 21-in. walls, is located on the Catawba River, just above Fishing Creek dam. The water level was subject to variation from El. 404, normal low water, to El. 416.5, the elevation of the flood gate on the dam, and in extreme floods reached El. 435. Borings had indicated level bedrock at El. 396, lying below approximately 10 ft. of mud filled with the remains of an old timber bridge and parts of a newer steel bridge which had been washed off its foundation near the site. At the start of construction operations, the water level was about El. 412, due to withdrawals from the dam by a power company, and risking a flood stage, 20-ft. sheet piling was chosen for the cofferdam.

The cofferdam was designed as a true circle with a radius of 18 ft. 7 in. The timber ring sections were framed as trusses as shown in Fig. 1. Each piece was

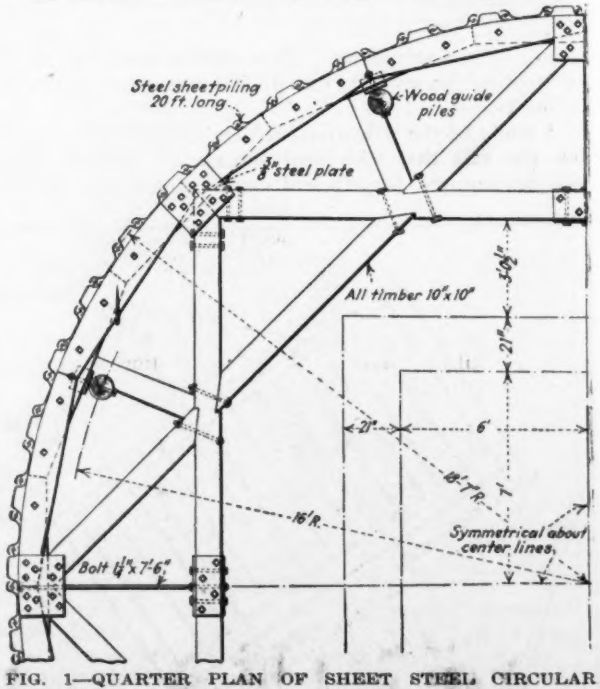


FIG. 1—QUARTER PLAN OF SHEET STEEL CIRCULAR COFFERDAM, WATER INTAKE, LANCASTER COTTON MILLS

Note how each timber piece was cut to fit and bolted into place. Three timber ring braces were used. When in final position, the lower ring was 2 ft. above the rock floor, the middle ring 6 ft. above the lower, and the top ring 8 ft. above the middle one, and 4 ft. below the top of the sheeting, 20 ft. long.

FIG. 2—FRAMING THE TIMBER TRUSS RING BRACING
The trusses were partly framed on the ground and then assembled in place at the intake site. Each ring weighed about 6 tons when complete.

cut to fit and assembled in place to make each ring a unit. Timbers 10x10 in. in cross-section were used, framed with ¾-in. and 1-in. bolts with iron plates used for connection between the struts and waling members. Four 1¼-in. 7-ft. bolts were used as tension members of the trusses. Three of these rings were made and placed at the proper elevation as the work progressed.

The first ring was assembled on a temporary falsework just above the water level and centered in place. Then eight wood guide piles, 25 ft. long, were driven inside this ring and against the timber circle. The guide piles were cut off 8 ft. above the first ring and a timber falsework was built on top of the piles. The second ring was then assembled on this falsework and placed in its true position over the first ring. These rings formed a guide by which the steel piling was placed. A third ring was placed inside the steel sheeting after driving began. Each timber ring unit weighed about 6 tons.

The steel sheet piling was placed in the complete circle before any driving was done. One hundred pieces of sheeting were theoretically required to make the closure, but 102 pieces were used in order that the timber bracing might slide into place easily. As the steel piling was placed, a special pitch of asbestos and grease was applied to the tongue of each piece, as a lubricant and for waterproofing the interlocks of the sheeting. The application proved effective. The steel sheeting was driven into the rock a few inches in order to secure a toe hold. The cofferdam was unwatered as the excavation progressed. A clamshell bucket excavated the material in the center of the cofferdam, and material around the edges that was too stable to flow toward the center was cast down by hand. As the excavated materials was removed, the two lower rings went down by their own weight until they were in the proper position, where they were held by scabs on the wood piles.

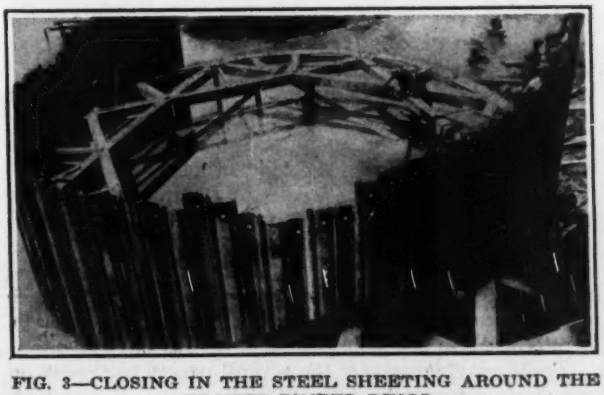


FIG. 3—CLOSING IN THE STEEL SHEETING AROUND THE FRAMED TIMBER RINGS

The steel sheeting cut through all the old débris encountered except one piece of old steel. Two blow-ins were experienced in the cofferdam before excavation had progressed far enough for this piece of steel to be removed and the piling at that point driven into the rock.

The water level reached to within a few inches of the top of the cofferdam, but never overtopped it. After the completion of the structure and before the equipment could be removed from the site a flood raised the water level to El. 429. The rock was excavated to a depth of 2 ft. under the intake structure, but the bottom of the cofferdam was not sealed. The intake structure has proved stable under all flood conditions, even though overtopped. It was one of the few in this part of the country that remained undamaged during the recent period of high water.

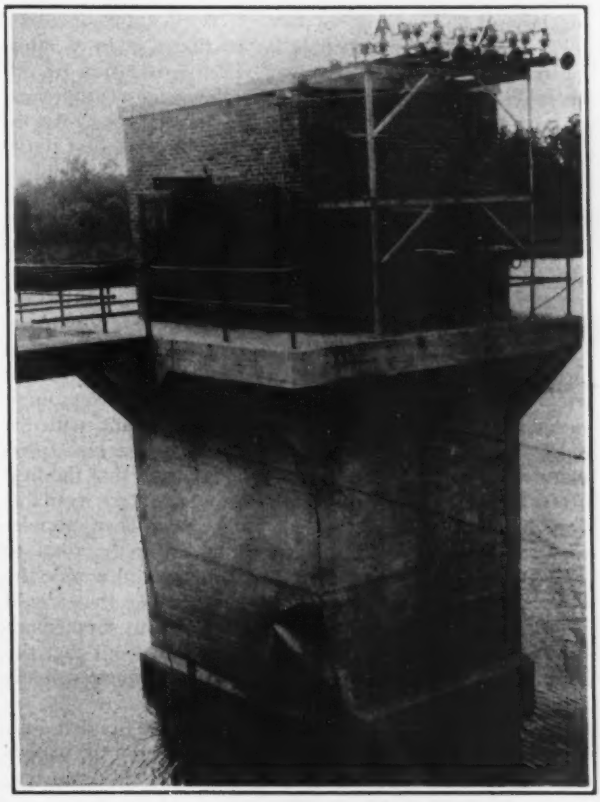


FIG. 4—INTAKE STRUCTURE COMPLETED

Tucker & Laxton, Inc., Charlotte, N. C., was both engineer and contractor on this work. E. L. Scruggs was superintendent in charge. The cofferdam was designed by the writer.

Low Bids Prevail Over Shorter Delivery Time

In a question arising out of a recent War Department contract for cast-iron pipe and fittings, the Comptroller General of the United States recently ruled that the award must be made to the low bidder, and that shorter delivery time offered by another bidder cannot be given consideration as a reason for not accepting the low bid. The call for bids did not specify that time of delivery would receive consideration, but each of the bidders was advised orally that time of delivery was important (*New Reclamation Era*, November, 1928).

Fabricators Discuss New and Broader Fields for Structural Steel

Airplane Hangars, Esthetics in Bridges, Flame-Cutting and Welding Among Subjects at Meeting of American Institute of Steel Construction—Better Buying and Selling Policies

IN BOTH technical and economic aspect the ninth annual convention of the American Institute of Steel Construction held Nov. 13-18 at Biloxi, Miss., was notable. Added to an excellent list of technical subjects were several addresses and papers devoted to problems of buying and selling as part of the inauguration of a new policy from which it is hoped that a code of ethics or trade practices will evolve. The registration of 300 members and guests constituted the largest attendance at any of the Institute's annual conventions. At the annual banquet the fabricators were addressed by Charles M. Schwab, Bethlehem Steel Company; Arthur Meighen, K. C., Toronto, Canada, and Lieut. Commander C. E. Rosendahl, Naval Air Station, Lakehurst, N. J.

F. H. Frankland, in charge of the technical service of the Institute, called attention to the work of the field engineers who have been operating for five months and through whose promotional work it has been possible to trace the use of some 43,250 tons of steel in buildings and bridges. The contacts which these field engineers make are twofold, on the one hand with the architects, engineers and public officials and on the other hand with the sales forces of the fabricating industry. Lee H. Miller, chief engineer of the Institute, also reported that the first 10,000 of the Institute's handbooks which were available for distribution in January, 1928, have been supplemented by three more printings, to bring the total to 40,000 copies. The handbook was devised to enable the buyer to specify steel products in a manner that would insure fair competitive conditions and also to supplement data in existing text books. It was pointed out that the handbook is being used by 80 or more technical schools at the present time for the latter purpose.

The activities of the convention can be divided into three rather distinct groups—reports, technical papers and papers bearing on the economics of the industry. These will be taken up in order.

Reports of Committees

Reports—The committee on technical research reported its co-operation during the past year with the structural steel welding committee of the American Bureau of Welding. It was recommended that the Institute appropriate $5,000 to assist in the completion of the work of the structural steel welding committee. As a basis for additional work during the coming year the technical research committee reported that it had obtained, through the courtesy of the Carnegie Steel Company, specimens to be used in an investigation of the cutting of structural steel with the oxy-acetylene torch.

The committee on esthetic design of steel bridges recommended that an annual award be made for the bridge constructed during the year which would be chosen by a selected art jury as the most artistic in treatment. Such a bridge would be decorated with a plaque, and complete engineering and architectural descriptions would be published. In addition, the committee recommended that an illustrated report be compiled on artistic bridge designs and that the problems of esthetics in bridges be treated in a series of lectures. It was proposed by the committee that two series of cash prizes be established, one to go to students in engineering and architecture and the other to practicing engineers and architects for the best competitive bridge designs.

Report of the Chief Engineer

The report of Lee H. Miller, chief engineer of the Institute, listed numerous changes and additions that have been made in the Institute's standard specification for design, fabrication and erection of structural steel. Among these was a revision which confined the steel used under the specification to that manufactured by the open-hearth process. The subject of tension in rivets has also been considered as one requiring some clarification in the specification, but in the opinion of the chief engineer the engineering profession is not yet ready to accept the unrestricted application of tension stress to rivets and the Institute's specification as it now reads adequately defines the conditions under which rivets may be used to carry tension stresses.

It has been established that there are three conditions which contribute to loose rivets—paint on contact surfaces, overheating, and subjection of rivets to the vibration of the pneumatic gun after their temperature falls below 1,000 deg. F. All of these conditions have been prohibited by revisions to the Institute's specification. Inasmuch as tests made on plates cut by shears, by the milling cutter and by the flame-cutting torch showed specimens prepared by the latter method to be in every way equal to those made by the milling cutter and superior to those cut by shearing, a revision has been made which gives approval to the use of flame-cutting in more precise terms than were contained in the original specification.

University Fellowship Announced

The report announces the establishment of a fellowship at Ohio State University to study the problems involved in designing structures to resist wind. On the basis of the work of this fellow, who will be assisted by Prof. Clyde T. Morris of Ohio State University, H. T. Balcolm of New York, Aubrey Weymouth of New York and Mr. Miller, it is hoped to promote uniform practice in the design of wind connection details.

During the past year the Institute has made available a tentative specification on fireproofing. To meet a demand for authoritative data on the insulating properties of various materials, the Institute has made arrangements with the manufacturers to conduct tests on their different materials and the results of these tests should be available within the year. A further study of floor designs was recommended and Mr. Miller expressed belief in the possibility to develop an all-steel floor construction properly protected from fire on the ceiling side, which would reduce the dead load of floor construction by 20 lb. or more per square foot.

Technical Papers—Of the several papers presented on technical subjects those on "Welding as a Fabricator's

Tool," by Fred T. Llewellyn, and "Flame-Cutting of Structural Steel," by F. W. Miller and J. R. Dawson, will be omitted from this report and abstracted in more detail in a later issue.

Airplane Hangar Construction

Of the other papers, that on "Airplane Hangar Construction," by Major Frank M. Kennedy, Air Corps, U. S. Army, reviewed the efforts of the War Department to design hangars during the recent war and explained the differences in design which have been developed since the initiation of the five-year aviation program. Mr. Kennedy pointed out the existence in hangar design of a definite ratio between width and height of 4:½ or 5:1, so that the only variable is the length of the hangar, which in turn depends only on the number of planes to be housed. In view of present plane requirements Mr. Kennedy believes the most economical hangar width is about 110 ft., with a height of 20 ft. Also, in his opinion, there are no military plane designs in sight for the next ten years that will require greater hangar dimensions. "The tendency has been toward long buildings," said Mr. Kennedy, "principally for the reason that the cost of end or door bays is less than that of intermediate bays. In my opinion, however, a 110-ft. hangar, 100 or 120 ft. long, will be found to be much cheaper to operate at a commercial airport than one of 240 ft. length."

A paper by J. Edward Cassidy, consulting engineer, Washington, D. C., on "Structural Steel in the Federal Building Program," called attention to the authorization by the last session of Congress of a general building program involving $250,000,000. The paper pointed out the necessity for the structural steel industry to keep in close touch with federal matters in order to be familiar with governmental methods of bidding, etc. Discussing the Aeronautic Branch, Department of Commerce, Mr. Cassidy said: "Commercial planes are now being built abroad which have a wing spread of 165 ft. and an overall height of 26 ft. Hangars for such ships must have clear spans somewhat in excess of the total wing spread so that in the case of large ships of this type the use of structural steel is obligatory. The structural steel industry should start now in planning to meet this important demand which is coming rapidly."

Clinton T. Bissell, associate consulting engineer of the National Board of Fire Underwriters, read a paper on "The Work of the National Board of Fire Underwriters," in which he explained the organization's methods for assisting toward better building construction by stimulating interest in sound building principles by research and test.

Steel Joists

"Steel Joists and Their Application to Structural Steel Buildings" was the title of the paper read by Frank Burton, consulting engineer, Detroit, Mich. "The great variation in the capacities of joists manufactured by different companies has made it difficult to design with steel joists, and one of the great needs of the industry today is a standardization of joists," said Mr. Burton. In addition the great variety in methods of calculation has militated against their use. Attention was called in the paper to the necessity of bridging steel joists during erection, for it is then that they are in their most unstable condition without the lateral support afforded by the finished floor. For fireproof construction steel joists have the great advantage of expanding in only one direction and if one end of the joist is left free there is little stress developed in the direction of the joist with consequent reduction in structural failures, in Mr. Burton's opinion.

J. Horace McFarland, chairman of the Art Commission of Pennsylvania, addressed the convention on "Beauty in Bridges."

The Business Side

A paper on "Legitimate Combinations for Better Business Conditions," by Charles H. McDonald, manager, market research department, Colorado Fuel & Iron Company, urged a unity of effort and co-operation in the steel industry on the part of both producers and fabricators. Among the definite suggestions he made for better business conditions in the steel industry were the following: Educate the public through a well-planned national campaign of publicity financed by a small levy on every ton of American steel production; establish and clearly define a marketing policy; devote more effort and money to neglected markets; create a fund for the development of new uses for steel; organize a bureau which could offer to any industry using or contemplating the use of steel all the facilities of the entire steel indusry; give more attention to the individual fabricators and users of structural steel, helping them to increase profits by diversification, reduction of shop overhead and selling expense; follow the lead of other organized industries in protecting themselves against proposed unfavorable legislation and unitedly working for the revision or revocation of existing laws or statutes that may be obsolete or out of line with changed conditions.

Other papers on the business aspects of the steel industry were "The Buyer's Attitude as Related to the Present Competitive Conditions Among Sellers," by L. F. Bossey, editor, *The Purchasing Agent*; "The Character of Salesmanship Essential to Meet Present-Day Economic Conditions," by C. K. Woodbridge, president of the Kelvinator Company, and "The Government's Attitude Toward Present Economic Conditions," by Abrams F. Meyers, Federal Trade Commission, Washington, D. C.

W. M. Wood, president of the Mississippi Valley Structural Steel Company and president of the American Institute of Steel Construction, reviewed with satisfaction the increasing support given the steel fabricators by the producers but at the same time indicated that there was a need for this financial support to come from united group action of the mills rather than from the individual organizations.

Selling Ethics Advocated

Charles F. Abbott, executive director of the Institute, in his annual report recommended the preparation of a code of selling ethics for the industry and called attention to the obsolete features and doubtful elements in the Sherman anti-trust law. Mr. Abbott lists the three necessities of the structural steel industry as a solution of overproduction, an understanding of costs and their proper use in establishing sales prices and an understanding and application of intelligent, aggressive salesmanship. Mr. Abbott said: "Strict adherence to the one-price policy is a basic fundamental of sound salesmanship. Any disregard of this policy is to invite a price war that dissipates profits and places the whole structure of the industry's selling at the mercy of the buyers. If price concessions are to be made, they should only follow as a result of cost reduction instead of cutting into the reasonable margin of profit."

State Highway Officials in Annual Convention

Discuss Highway Progress, Legislation, Standards, Prequalification of Contractors and Research in Weight Proportioning and Urge Increase of Federal-Aid Appropriations to $100,000,000 a Year

HIGHWAY officials from 45 states met in Chicago, Nov. 12-15, and carried forward the work of the fifteen standing committees through which their association functions. About 325 were in attendance. A new president, John N. Mackall, chairman and chief engineer, Maryland Highway Commission, was elected. The report of the treasurer, W. W. Mack (Delaware), showed a prosperous financial condition. A notable report by the executive secretary, W. C. Markham, covered the statistics of roadbuilding, gasoline and motor vehicle license taxes, federal appropriations and expenditures, congressional legislation, changes in state officials and various routine matters of association administration.

Present Status in Road Surfacing—During 1928 about 19,000 miles of state-system roads were given some kind of surfacing and 7,000 miles of earth roads were prepared for surfacing. At this rate of construction it will require eight years to surface the state systems. The entire state-system mileage is less than 20 per cent paved and less than 47 per cent surfaced with gravel or higher type construction. There are eight states whose systems are not 50 per cent graded and drained to engineering standards. Summarized, there are 301,191 miles of state-system roads, of which 45,654 are paved and 152,217 miles (including pavement) are surfaced. Three states have more than 5,000 miles of paved road: New York 7,813 miles, Pennsylvania 6,852 miles and Illinois 5,249 miles. The average expenditure for the year on state-system roads was $2,089 a mile.

Pending Legislation — Of the various bills before Congress particular attention was directed (1) to the toll-bridge bill sponsored by the association, which remains in the committee on interstate and foreign commerce without action, and (2) to the acts to place control over franchises and rates of buses and trucks in the hands of a federal commission. It was noted that during the last session of Congress there were introduced 201 toll-bridge bills. It was also noted that more active interest will have to be taken in the legislation respecting control of bus and truck licenses and rates if the association, as heretofore, desires to retain this control for the states.

Adoption of Standards—During the year there were adopted seventeen new or revised standards of practice. Important among these were: 6-in. minimum thickness of concrete pavement; 10-ft. traffic lanes; 8-ft. minimum width of shoulders; longitudinal joint with dowel bars across the joint; 1-in. crown for two-lane concrete pavement; a standard motor-vehicle accident report card; and weight proportioning of concrete.

Committee Reports—Reports of progress or of recommended action were made by all of fifteen of the standing committees. Conferences with the A.R.E.A. on steel highway bridges have been completed and the specifications are now before the railway association for formal adoption. A study of transverse test practices is being made, to arrive at a standard which can be adopted in all states and so make test results comparable. A study is being made of equipment for proportioning concrete by weight to arrive at principles and practice which will insure accurate results. Much of the present equipment does not give this assurance. A study is also in progress to determine some form of reliable consistency test.

The committee on design recommended the following classification of roads: Class A, carrying 4,000 or more vehicles a day and having more than two traffic lanes paved; Class B, carrying 1,200 to 4,000 vehicles not more than 10 per cent trucks and having two traffic lanes paved; Class C, carrying less than 1,200 vehicles not more than 10 per cent trucks and having two traffic lanes surfaced. It also recommended (1) 24-ft. paved width at curves, (2) all curves to be superelevated, (3) broken-back curves to be eliminated, and (4) a sight distance of 500 ft.

Two reports of particular significance were presented by the committee for co-operation with contractors and the committee on maintenance. The report of the committee on co-operation with contractors recommended the prequalification of bidders and urged action by the association. By vote of the convention the recommendation was ordered to be submitted to the executive committee and by it put to letter ballot by states. The Bureau of Public Roads and the states of Wisconsin and Iowa now require prequalification of bidders. The maintenance committee presented an indexed digest of maintenance practice in 43 states. This was a typical document of several hundred pages and a copy will go to every state highway department.

Resolutions — Resolutions were passed as follows: Urging an increase of federal-aid funds to $100,000,000 a year for states and $10,000,000 a year for forest roads; requiring that federal-aid funds be all devoted to work on the present federal-aid system; against the building of toll bridges financed by private funds but allowing public toll bridges to be built; urging extra federal aid for public land states.

General Papers—There was a considerable program of general papers besides the formal committee reports, among which were: "Highway Problems in Metropolitan Areas," by Robert Kingery, of the Chicago Regional Planning Association; "The Toll-Bridge Problem," by J. S. Watkins, state highway engineer of Kentucky; "Highway Finances in Public Land States," by Henry H. Blood, chairman of the state road commission of Utah; and "Economics of Snow Removal," by C. M. Babcock, commissioner of highways of Minnesota. Thomas H. MacDonald, chief of the Bureau of Public Roads, reviewed briefly the broad national problems in highway development, and Samuel Eckels, chief highway engineer of Pennsylvania, described the policing of state highway systems.

Red Cross Mississippi Flood Relief

Figures made public by the American Red Cross reveal that the Red Cross spent for the relief of Mississippi flood sufferers last year $16,994,868.61. The report shows that the organization cared for 637,000 during the flood.

Resurfacing Old Macadam Roads in Johore, Malaya

Excessive Maintenance Costs Reduced by the Use of Asphalt — Reinforced Asphaltic Concrete Used for Curbs

By F. M. Starling
Singapore, Malaya

MALAYA, now undertaking an extensive roadbuilding program with $10,000,000 available — more money than the engineers at this time are in a position to expend—is following to a great extent American methods of construction, including the use of asphaltic concrete and asphalt macadam surfaces with inverted headers or curbs reinforced by expanded metal. The work is being done largely by the Asphalt Paving Company, Ltd., of Singapore.

Shortly after this company was organized it obtained a contract from the Johore provincial government to lay 10 miles of 16-ft. road with hot-mixed asphalt macadam. The contract price was $134,000. Actual laying began in

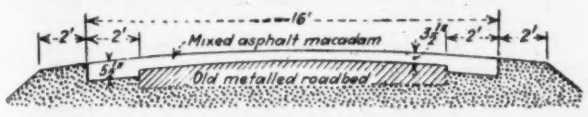


FIG. 1—ASPHALT MACADAM ROAD IN JOHORE, MALAYA

August, 1927, and the 10 miles was completed on Feb. 26, 1928, about six months calendar time, but actually less than five months working time, as a large amount of time was lost due to rain.

The stretch of road covered with hot-mixed macadam comprises a section of the main road which connects Singapore with the upper part of the peninsula. It is located between the 22d and the 32d mile on the Johore Bahru-Batu Pahat road. The highway is bordered partly by rubber lands and partly by primeval jungles. It is low lying and swampy in places. The original roadway was cleared and graded fifteen years ago and since that time a waterbound macadam road has been maintained by the state at much expense and trouble. Part of the old road had received a surface coating of asphalt. The grade was 16 ft. wide but the metaled surface was only 12 ft. wide. The bed was well compacted and in most places drainage was good. Where necessary subsoil pipes were laid to give needed drainage and where the grade had broken down or washed away it was brought up to full width.

FIG. 2—LAYING HOT-MIXTURE ON OLD MACADAM

FIG. 3—ASPHALT SURFACE ROLLED READY FOR SEAL COAT

The hot-mixed asphalt macadam was laid over the old metaled roadbed without disturbing the surface. Where the old roadbed was off grade the thickness of the hot mixture was varied when necessary in order to give the proper grade to the finished new surface. For 2 ft. on each side of the old metaled road 5½ in. of compressed mixture was laid, whereas on the 12 ft. in the center of the road 3½ in. of compressed material was laid. A shoulder 2 ft. wide was built up on each side previous to laying the hot mixture. Curbs of expanded metal were used. Fig. 1 is a cross-section of the finished road.

Crusher-run granite was used as the aggregate. There was no grading of the stone. The crushers were set for

FIG. 4—PAINTING GANG APPLYING SEAL COAT

1½-in. stone. As the stone came from the crushers it was elevated immediately to the bins and from there passed directly into the drier without screening or grading and thence to the hot stone bin and the pug mixer. No filler was used. From 4 to 5 per cent of steam-refined asphalt of 40-50 penetration was mixed with the crusher-run granite, which ranged in size from 1½ in. down to dust, the stone being a hard granite which breaks well. The resultant mixture when rolled with 10-ton rollers gave a closely compacted pavement. A ½-in. seal coat was added by painting with the same penetration asphalt.

This pavement, perhaps not as stable as a carefully graded asphalt concrete, will nevertheless serve requirements for the next twenty years. Doing away with the expensive upkeep, which amounts on waterbound macadam road in Johore to $1,000 per mile per annum, relieves the staff of the state engineer for work required

in opening up new roads. These are the reasons for adopting this type of pavement by Johore. In Malaya, where rainfall is very large, the road engineers have great difficulty in protecting the roadbeds and maintaining surfaces. Asphalt macadam of the hot-mixed type has gone a long way toward solving this problem.

This 10 miles of pavement was the first attempt to lay hot-mixed pavements in Malaya outside of Singapore City. Some delay was experienced in getting the undertaking into full swing, but due to the very capable direction of Ian Fraser, an experienced roadbuilder and engineer who came out from Scotland to assume the active management of the Asphalt Paving Company, Ltd., and R. A. Felton, asphalt road expert of the Standard Oil Company of New York, who acted as consulting engineer to the new company, this first hot-mixed pavement in Malaya was laid rapidly and successfully.

Correction for Orthotolidin Test

Because both working results and supplementary laboratory tests have indicated that color already present in water before making use of the orthotolidin test for residual chlorine may lead to confusion and to a deficient rate of application of chlorine, it is recommended in a short article in the New Jersey *Public Health News* for October-November, 1928, that color determination of water be made on samples taken before the chlorine is applied. If these preliminary samples show color, it is recommended that the latter "be compensated for when making the residual chlorine test on the final water by subtracting the amount found in the raw or filtered water from that found in the final. The difference will represent the actual residual chlorine." This recommendation is included in notes by Leroy Forman, senior chemist, bureau of engineering, State Department of Health, Trenton, N. J. Mr. Forman states that several recent examinations of New Jersey water supplies have shown B. coli present in all portions examined, notwithstanding the fact that the monthly report submitted to the department showed residual chlorine each day. In a case specified in some detail in Mr. Forman's notes it was found that manganese in the water was responsible for the color. Mr. Forman states that "manganous compounds do not react with orthotolidin, but as they begin to oxidize, color is produced." This production of color as well as the interference of iron is being studied in the laboratory of the State Department of Health.

Application Form for Cross-Connection in New Jersey

Those who wish to continue old or to establish new cross-connections between a public potable water supply and an unapproved water supply in New Jersey will be required to fill in an "Original Application" blank, a form for which was adopted by the New Jersey State Department of Health on Oct. 30. Quotations will be made in accordance with Chapter 13 of the Sanitary Code. (See *Engineering News-Record*, Oct. 18, 1928, p. 602.) The blank contains a space for giving the name of the public potable and the unapproved water supply; the name of the plant and street location; number, size and location of all physical connections on which all-bronze double-check valves are to be installed; the name of owner of connection, with address and name of applicant, including title. Then follows space for two indorsements: (1) A certificate that the water company or local municipal water department recommends the approval of the application by the State Board of Health. (2) A certificate that the application has been investigated and that the physical connections described therein will (or will not) comply with the provisions of Chapter 13 of the Sanitary Code, followed by a recommendation that the permit be (or be not) granted.

The back of the application form is explanatory of the matter along the lines indicated in the foregoing statement, followed by a paragraph reading thus:

"State Department of Health will issue a permit in triplicate to the local board of health, if recommendations are favorable, to maintain or install a physical connection. The owner making application will be notified as to the above action. The existence of the permit will be for a period expiring on April 1, 1930, unless revoked due to the improper or inadequate operating, or the improper or inadequate construction or functioning, of the physical connection."

The explanatory matter also states that if the owner of the cross-connection so desires he may make an application for the renewal of the permit prior to April 1, 1930, if the same general procedure is followed as in the case of an original application. A form headed "Renewal Application" will be furnished by the State Department of Health, and on this form is to be reported information on inspections and maintenance of physical connections.

H. P. Croft is chief engineer of the New Jersey Department of Health.

New Machine Tool Material of Unusual Quality

A new kind of machine-tool material known as Carboloy and composed of tungsten carbide and cobalt was announced by Dr. Samuel L. Hoyt, of the research laboratory of the General Electric Company, at the annual convention of the American Society for Steel Treating at Philadelphia on Oct. 11. The carbide is extremely hard and the cobalt gives the material the necessary strength for use in cutting tools. According to Dr. Hoyt, "the new material can machine harder and denser grades of steel than can be handled economically by high-speed steel; and steels with higher alloy contents than are now commercially machinable will be brought into the machinable class." It is particularly applicable to the field of weak or low tensile materials which are also uncommonly abrasive to present tools. It is claimed to be particularly applicable for drilling holes in concrete and rock, in which service it is claimed that Carboloy is less expensive than diamond drills and cuts a smoother hole than the hammer drill. Cast-iron castings can also be cut easily with the new material. On the Brinell scale Carboloy shows a hardness of 2,000 and above, as compared with an average maximum hardness of 850 for common tool steel and about 1,000 for the hardest steel.

Change Double Track to Single Track

The very unusual process of converting double-track lines to single-track is to be undertaken by the Great Southern Railway, of Ireland. According to a statement in the *Railway Gazette*, London, the purpose of the change is to effect economies in operating and maintenance expenses, while the traffic is not heavy enough to require double-track operation. This change will include the 126-mile main line across the island from Dublin to Galway, while four other lines aggregating 62 miles will bring the total up to 188 miles.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Capping Device for Concrete Cylinders

By P. J. Freeman

Chief Engineer, Bureau of Tests and Specifications, Department of Public Works, Allegheny County, Pittsburgh, Pa.

FOR about two years the Allegheny County Department of Public Works laboratory has been using a method of capping concrete cylinders by which it is possible to make a perfect cap on any specimen regardless of its irregularity and have it ready to test within ten minutes after arrival at the laboratory. A quick-hardening compound has been obtained which when poured hot will adhere to any specimen and is particularly suitable for concrete cores. This is a commercial product known as Baselit and is a compound of sulphur 50 per cent, silica 32 per cent, alumina 9 per cent and smaller amounts of other materials.

It is necessary to have the specimens in a horizontal position in order to form the caps properly. For that purpose a device (Fig. 1) not unlike a lathe-bed was devised, which supports the specimens in movable V-blocks. Flexible bands are placed around the ends of the cylinder and in contact with the machined plates of the capping device. By means of a hand-wheel the position of the end plates is adjusted. The compound is well heated and poured into the flexible bands so as to cap both ends. The appearance of the cap is highly polished (Fig. 2) and both ends are perfect planes parallel to each other.

The crushing strength of the capping compound is about 8,000 lb. per sq.in. when tested as a 2x4-in. cylinder. A flat thin specimen 6 in. in diameter has a crushing strength far above this, and for that reason the full compressive strength of the concrete is always developed when this method is used.

The caps adhere firmly to the concrete, and in order to show this a specimen was broken with a bearing plate having a diameter approximately ½ in. less than the diameter of the cap. It will be observed (Fig. 2) that the plate sheared through the capping material but did not loosen it from the ends of the broken pieces. The thickness of the caps need not be any more than necessary to true up the irregular surfaces.

The cost of the material for capping both ends of a single specimen is approximately 8c., and it is possible to break the caps from the concrete and melt them over once or twice until the concrete particles become too many to give a smooth surface. The cost of using this material is probably a little more than that of other methods, but the quality of the cap obtained is always above criticism and the full strength of the concrete will be obtained.

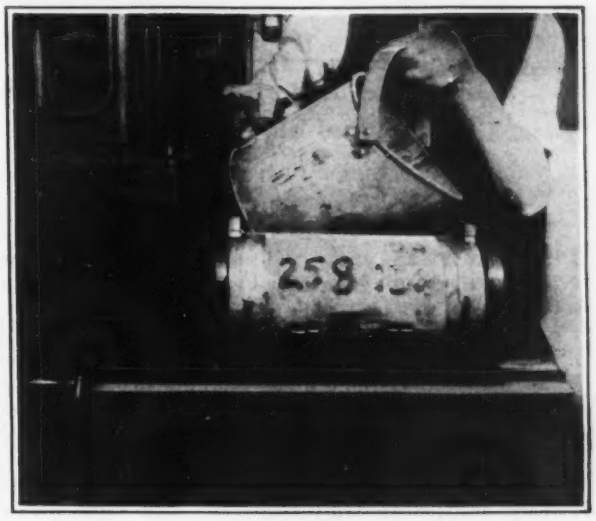


FIG. 1—DEVICE FOR CAPPING CONCRETE TEST CYLINDERS OR CORES

Guarding Against Disease After Floods

FOLLOWING the disastrous flood in the Rondout Valley, New York, last summer, the division of sanitation of the New York State Department of Health sent instructions to all health officers in the flooded district giving precautions to be taken in guarding against the spread of disease due to polluted wells in the region. For the average size dug well, assumed to be about 4 ft. in diameter and containing about 15 ft. of water, the following directions were given for for disinfection:

Put one can (12 oz.) of chloride of lime (obtainable at any grocery store) in a pail and add sufficient warm water

FIG. 2—EXAMPLE OF CORE CAPPED AND BROKEN
A—Core showing irregular end. *B*—Core after capping. *C*—Core broken with cap.

(about ½ cup) to make a paste, which will facilitate dissolving the powder. The paste should be stirred thoroughly to break up any dry lumps. Then add water gradually to the paste until the pail is about three-quarters full, at the same time stirring the water so that the chloride of lime is dissolved as thoroughly as possible. Pour the solution into the well and stir if possible. Allow the disinfecting solution to remain in the well overnight and then pump out the well if a strong taste of chlorine is noticeable. The well should then be safe to use in so far as any residual contamination from the flood may be concerned.

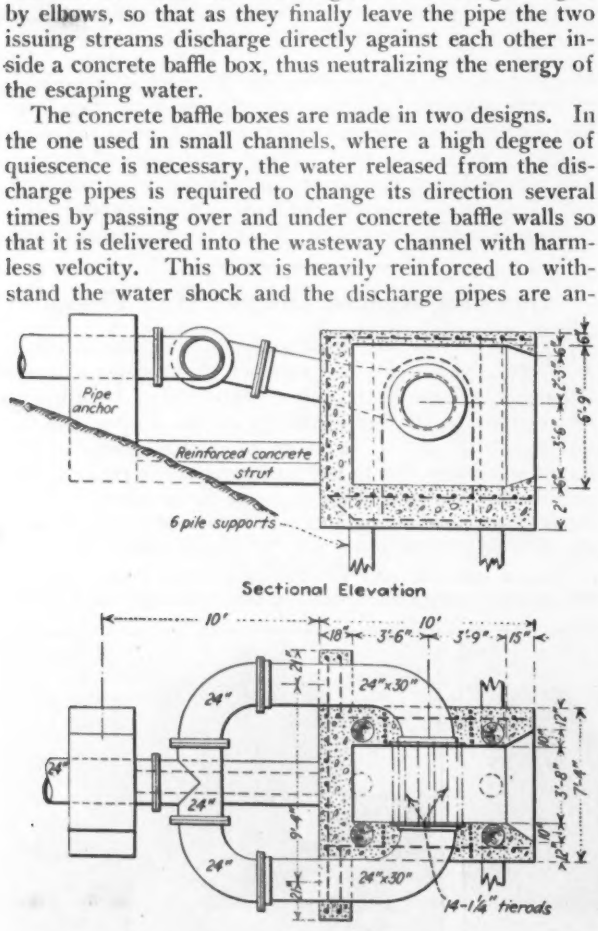
Baffle Boxes Absorb Energy From High-Head Blowoff Valves

By F. W. Hanna,
Chief Designing and Hydraulic Engineer, East Bay Municipal Utility District

IN DESIGNING the aqueduct that is to deliver the water supply of the Mokelumne River project being developed by the East Bay Municipal Utility District, it was necessary to provide for the occasional discharge of water from the main aqueduct into waste channels under comparatively high heads. To prevent destructive erosion, this necessitated some means of absorbing the energy of the discharging water and a concrete baffle box as described in the following was therefore designed.

The discharge pipe is first divided in a T and both branches are then turned through two more right angles by elbows, so that as they finally leave the pipe the two issuing streams discharge directly against each other inside a concrete baffle box, thus neutralizing the energy of the escaping water.

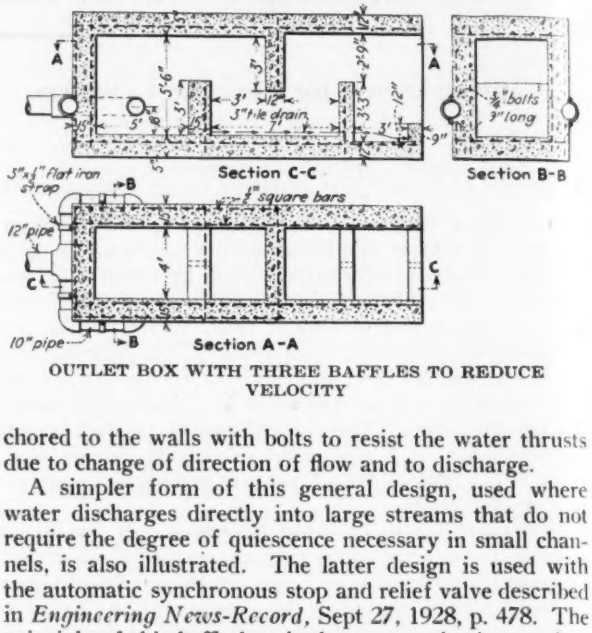
The concrete baffle boxes are made in two designs. In the one used in small channels, where a high degree of quiescence is necessary, the water released from the discharge pipes is required to change its direction several times by passing over and under concrete baffle walls so that it is delivered into the wasteway channel with harmless velocity. This box is heavily reinforced to withstand the water shock and the discharge pipes are anchored to the walls with bolts to resist the water thrusts due to change of direction of flow and to discharge.



OUTLET ON STREAMS WHERE MORE VELOCITY IS PERMISSIBLE

From Job and Office

Hints That Cut Cost and Time



OUTLET BOX WITH THREE BAFFLES TO REDUCE VELOCITY

A simpler form of this general design, used where water discharges directly into large streams that do not require the degree of quiescence necessary in small channels, is also illustrated. The latter design is used with the automatic synchronous stop and relief valve described in *Engineering News-Record*, Sept 27, 1928, p. 478. The principle of this baffle box is the same as in the one just described, but the diameter of the discharge pipes increases toward the outlet, the two ends of the discharge sections of the pipe are held together with a series of tie rods to resist the greater end thrust and the outer end of the more elaborate baffle box has been omitted.

Stirrup Spacing in Concrete Beams

By Jacob Feld
Consulting Engineer, New York City

BY A slight algebraic alteration of the usual formula for the spacing of stirrups and the determination of a shear increment (or, rather, decrement) value for the loading on a beam, the accurate spacing of all stirrups for any load combination can be obtained very quickly by slide rule manipulation with one setting and some easy mental arithmetic.

The usual formula for spacing of vertical stirrups is: $S = \frac{A_v f_v jd}{V_1}$, where f_v = tensile unit stress in web reinforcement and A_v = total area of web reinforcement in tension. But V_1 = shear taken by stirrups = $bjd(v - 40)$, where v is the total unit shear at any section. Substituting,

$$S = \frac{A_v f_v jd}{bjd(v - 40)} = \frac{A_v f_v}{b(v - 40)}$$

For any definite case, $\frac{A_v f_v}{b}$ is constant and various possible values are given in the table herewith. In design of beams, it is necessary to obtain the maximum v at the support. At the same time the decrement of v (the slope of the shear diagram) or the decrease in v per foot of span can easily be determined.

To space the stirrups, all that is now required is to

From Job and Office

For Contractor and Engineer

set unity of the slide at the proper factor on the "D" scale of the ordinary Manheim slide rule. The stirrup spacings are now read on the "D" scale by setting the indicator on the quantity $(v - 40)$ on the "C_1" (red or inverted) scale on the slide. At the support, v is the maximum unit shear less 40 lb. per sq.in. From this subtract the decrement for the distance covered by the first spacing to obtain the v for the second stirrup. With a little practice figuring the decrement mentally, all the stirrups required can be spaced in a short time.

For double stirrups the factors are doubled. Factors vary inversely as the width of beam and directly as the size of stirrup and the allowable unit stress.

TABLE OF FACTORS
f_v = 16,000 lb. per sq.in.

b (Width of Beam), In.	½-Rd. Stirrups	¼-Rd. Stirrups
8	440	784
10	352	626
12	293	522
14	252	448
16	220	392
18	196	348

The formula as given above is equivalent to the one in the Joint Committee Specification, section 125. It differs from the method recommended in many text-books where a factor of $\frac{7}{8}$ is inserted in the formula for stirrup spacing, resulting from the assumption that the concrete takes one-third of the shear for all values of v. This is not reasonable; for low shears, below 120 lb., this assumption is equivalent to the statement that the shear strength of concrete (*per se*) is reduced by the addition of stirrups. The majority of recent tests recommend a constant value of shear strength of concrete without consideration of the existence of stirrups.

For example, see Fig. 2, p. 447 and p. 435, Hool & Kinne "Structural Members," $b = 11\frac{5}{8}$ in., $\frac{3}{8}$-rd. stirrups at 16,000-lb. stress.

v = 94 lb. per sq.in. Decrement $v = \frac{1{,}000}{18{,}000} \times 94 = 5.2$ lb. per sq.in. per foot (uniform load is 1,000 lb. per foot, reaction is 18,000 lb.).

STIRRUP SPACINGS
Factor is 302

First stirrup	302 ÷ (94—40)	= 5½ in.	Decrement is 2.5
Second stirrup	302 ÷ (54—2.5)	= 6 in.	Decrement is 2.7
Third stirrup	302 ÷ 49	= 6 in.	Decrement is 2.6
Fourth stirrup	302 ÷ 46	= 6½ in.	Decrement is 3
Fifth stirrup	302 ÷ 43	= 7 in.	Decrement is 3
Sixth stirrup	302 ÷ 40	= 7½ in.	Decrement is 4
Seventh stirrup	302 ÷ 36	= 8½ in.	Decrement is 4
Eighth stirrup	302 ÷ 32	= 9½ in.	

which brings the last stirrup 5½ in. from the concentrated load. Beyond the concentrated load the shear is 16 lb. per sq.in. and no stirrups are required.

Spacing of stirrups given in fractions of an inch is a waste of time. The above spacing, given as 4 to 6, 2 to 7, 2 to 8, is as accurate as any lather foreman can be relied upon to follow and certainly close enough to the theoretical spacing to suit the most conscientious designer. The computation then becomes:

302/54 = 5½ ..... use 4 to 6 in., decrement is 10.4
302/43.6 = 7 ..... use 2 to 7 in., decrement is 6.1
302/37.5 = 8 ..... use 2 to 8 in.

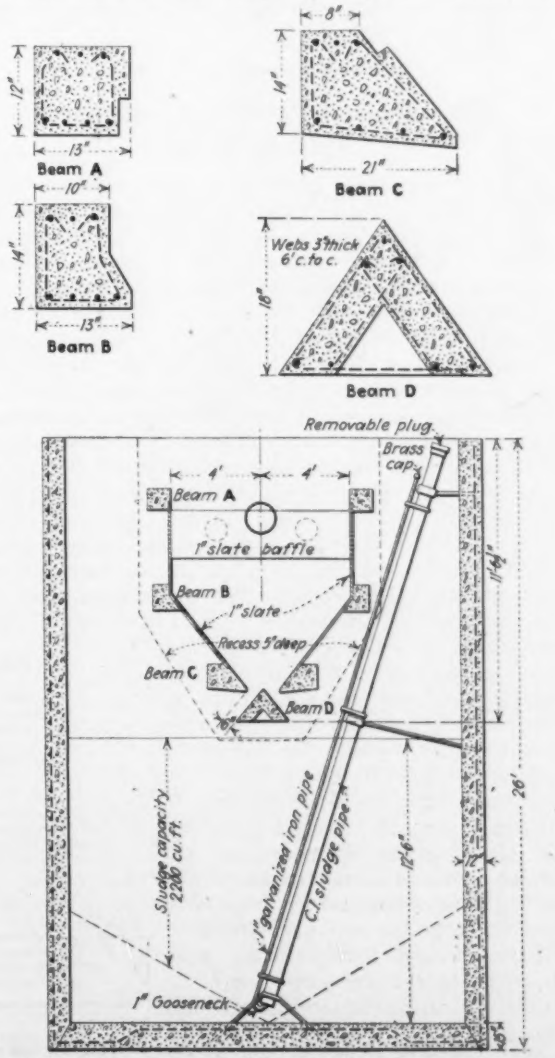
A little practice will show this method to be a good time saver.

Slate Baffles and Precast Concrete Beams for Imhoff Tanks

By Arthur S. Milinowski
Druar & Milinowski, Consulting Engineers, St. Paul, Minn.

THE comparatively high cost of formwork for reinforced-concrete settling compartments of small Imhoff tanks and the difficulty of obtaining really smooth surfaces and sharp corners with the customary construction led us several years ago to abandon this type of construction in many cases. Instead we have used and are now using the slate and precast beam construction illustrated in the accompanying drawing, so far with entire success.

When the walls of these settling compartments are built of reinforced concrete a few inches thick, it is necessary to build up a framework for the support of the forms all the way from the bottom of the Imhoff tank. These forms are thin and it is difficult to work the concrete into them and around the reinforcing bars without the constant danger of honeycombed surfaces. When the inverted V-shape deflector beam at the bottom of the compartment is cast in place, the usual result has been the destruction of the sharp edges by the carelessness



SMALL IMHOFF TANK WITH SLATE BAFFLES SUPPORTED ON PRECAST BEAMS

of workmen during the building of the remainder of the structures, one on either side. The mast arms were spaced 5 ft. apart and 2-in. boards were used for the flooring of the platform and were fastened to the 2-in. work. Usually the gunite method of building up these compartments is not economical for small tanks.

The slate and precast beam method has a number of advantages. The beams can be cast at odd times and be held in readiness for final setting. The slate work gives perfectly smooth surfaces. No expensive supports are necessary during construction. The beams are simply lowered into the proper position, supported by slings from above, wedged or blocked in place and the recess, temporarily left in the side walls of the tank into which the beams project, is filled with concrete to give the beam ends their permanent support. A little care in handling the beams from the place where they are cast into the tank prevents damage to their sharp edges. We have found that since a number of contractors have become familiar with this type of construction they are able to figure it more cheaply than the old style.

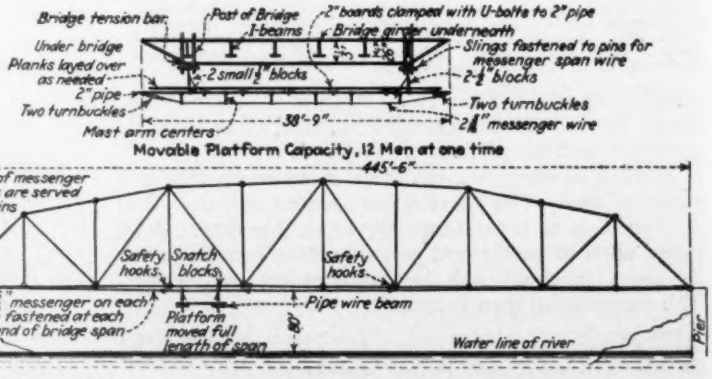
One precaution must be exercised in the maintenance of tanks built this way; they must be covered during the severe winter weather in this part of the country to prevent damage to the slate by unequalized ice pressure. However, adequate covering is nearly always provided in this part of the country.

Cleaning and Painting Underside of Railway Bridge

CLEANING and painting the understructure of a bridge on a line of the Charleston Interurban Railroad, Charleston, W. Va., was done successfully by constructing a movable platform and attaching it to two messenger wires running the length of the bridge underneath, says Thomas O. Smith, superintendent of overhead of the railroad, in the *Electric Railway Journal*, issue of Nov. 3, 1928. The platform was moved from one position to the next by sliding the snatch blocks, to which ropes fastened to the scaffolding were attached, along the messenger wire. When located, the platform was pulled up to working position and safety slings were attached to the bridge beams as found most convenient.

The side members of the platform were constructed of 2-in. wrought-iron pipe with mast arms hanging down. A $\frac{5}{16}$-in. wire attached to either end of the wrought-iron pipe passed through the ends of the mast arms and was tightened by turnbuckles. There were two of these structures, one on either side. The mast arms were spaced 5 ft. apart and 2-in. boards were used for the flooring of the platform and were fastened to the 2-in. pipes by U-bolts. The size of the platform was 38 ft. 9 in. x 42 ft. 9 in. and had a capacity of twelve men.

The messenger wire that supported the platform was run underneath the bridge from end to end and was tied to bridge pins. Other safety slings were tied to the bridge arms as found most convenient and safety hooks were fastened to the messenger wires at either side of the platform. By use of this construction the labor cost for the job was reduced approximately 30 per cent.



ABOVE, CROSSWISE VIEW OF THE PLATFORM AND ATTACHMENT. BELOW, LONGITUDINAL VIEW SHOWING HOW MESSENGER WIRE WAS ATTACHED TO PROVIDE EASY MOVEMENT OF THE PLATFORM

New Method of Computing Volumes From Planimetered End Areas

By W. R. Young

Senior Designer, Tennessee Highway Department, Nashville, Tenn.

WHERE the planimeter is used in securing the end areas of grading sections on highway or railroad work, the following method of computing the volumes will simplify the procedure.

USUAL METHOD

STA.	DIST	END AREA	STA AREA	CU.YD.
0		187		
+10	10	44	46	43
+50	40	12	44	41
1	50	70	82	76
+50	50	524	594	550
2	50	396	920	852
+50	50	468	864	800
3	50	235	903	651
+10	10	108	68	63
			TOTAL	3076

DESCRIBED METHOD

STA	DIST.	AREA÷54	CU.YD
0	10	3.46	35
+10	50	0.81	41
+50	90	0.22	20
1	100	1.30	130
+50	100	9.70	970
2	100	7.33	733
+50	100	8.67	867
3	60	4.35	261
+10	10	2.00	20
		TOTAL	3077

ALGEBRAIC DEDUCTION

$$\frac{(A_1+A_2)D_1}{2} + \frac{(A_2+A_3)D_2}{2} + \frac{(A_3+A_4)D_3}{2} = V$$

$$\frac{27}{27} \qquad \frac{27}{27}$$

$$1/54(A_1+A_2)D_1+1/54(A_2+A_3)D_2+1/54(A_3+A_4)D_3 = V$$

$$1/54(A_1D_1+A_2D_1+A_2D_2+A_3D_2+A_3D_3+A_4D_3) = V$$

$$1/54[A_1D_1+A_2(D_1+D_2)+A_3(D_2+D_3)+A_4D_3] = V$$

$$A/54\,(D_{Back}+D_{Ahead}) = V$$

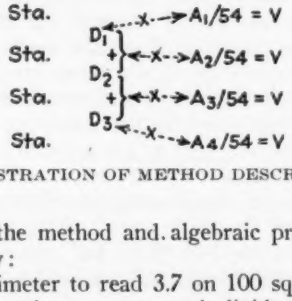


ILLUSTRATION OF METHOD DESCRIBED

Details of the method and algebraic proof of its deduction follow:

1. Set planimeter to read 3.7 on 100 sq.ft.

2. Run around area once and divide reading by 2. This will give $A/54$ instead of actual area.

3. Multiply $A/54$ by the sum of the distances on either side of the area.

This gives the yardage in units of one area and two distances instead of two areas and one distance. It will be noticed that where stations are 50 ft. apart the planimetered area is merely pointed off for volume.

Letters to the Editor

Transporting Paper Pulp Through Pipe Line

Sir—I note in your Nov. 1 issue, p. 667, a paragraph in reference to ground paper pulp in slushed form being transported 2 miles by means of a 10-in. line of cast-iron pipe, at the mills of the Thunderbay Paper Company.

A 16-in. wood stave pipe has been transporting slush ground wood from the Riley mill to the Otis mill of the International Paper Company, in Maine, a distance of 4 miles, for the past twenty years.

A. H. WHITE,
Vice-President and Chief Engineer,
International Paper Company.

New York City,
Nov. 3, 1928.

Concrete of Any Desired Quality

Sir—Your editorial in the Nov. 1 issue, entitled "What Grade of Concrete," will undoubtedly cause some readers to wonder what the reason was for writing it. Why not an editorial on "What Grade of Steel" or "What Grade of Timber"?

Admittedly there is much yet to be learned about cement and, to a lesser extent, about the making of good concrete. However, there is certainly no question that many instances of very satisfactory concrete are known which could not by any stretch of the imagination be called the *best* concrete.

The problem which just now is in need of investigation is not "How good is it possible to make concrete?" but rather "How good is it necessary to make concrete for specific uses?" This study must, of course, lead to investigation of the particular cements used.

In the meantime there is certainly no reason to suppose that concrete of any desired quality cannot be made. The problem to be solved is whether it can be made still more economically.

H. C. MCCALL,
Chief Engineer,
Concrete Engineering Service Company.

Cleveland, Ohio,
Nov. 9, 1928.

Criticism of A. S. Levens' Article on Shrinkage of Mortar and Concrete

Sir—With regard to A. S. Levens' article in the Oct. 4 issue of *Engineering News-Record*, p. 507, on the "Shrinkage Effect of Celite in Mortar and Concrete": Shrinkage of concrete is of primary interest to engineers, but no tests to determine this property are of value unless conducted with extreme care, all factors being controlled and a sufficiently large number of tests made to eliminate the experimental error. There are so many factors that affect shrinkage that its determination is most difficult and consequently there are little or no reliable data in the literature on this subject.

Since the magnitude of total shrinkage shown by the author is practically within the experimental error, since the author made only two tests of a kind with very small specimens, manufactured and exposed to only partly known and controlled conditions not simulating field conditions and since in some cases Celite mixtures showed more shrinkage and in other cases less shrinkage than plain mixtures, the results are meager, conflicting, unreliable and misleading. It is unfortunate that the article was printed as a conclusive piece of research, for it is not believed the author intended it to be so interpreted or presented.

Mortar Mixes—With reference to the mortar mixes, the work is confined to small laboratory tests on a 1 : 3 mortar mix with and without Celite. The article in question does not give any specific information regarding method of making tests, as, for instance, method and type of apparatus used, what manner of manipulation and to what degree the material was manipulated in making the specimens, what was the condition of the molds (wet, dry, oiled, etc.), whether the tests were all made on the same day or on different days or the samples for each condition all made on one day, nor is any indication given as to whether there was any change in humidity or temperature of the surrounding atmosphere if the tests were made on different days. As was pointed out by J. C. Pearson in his paper titled "Shrinkage of Portland Cement Mortar and Importance in Stucco" (*Proceedings*, American Concrete Institute, Vol. 22, p. 123), all of these variables have a marked effect upon the shrinkage of mortar specimens.

The figures shown in Mr. Levens' article were based on the average of only two tests, which is not sufficient in work of this type to produce averages which can be considered reasonably accurate. To point out a few indications of inaccuracy: (1) The specimens showed no appreciable shrinkage after the first few days up to 53 and 62 days, and yet after the moisture curing, in twenty days (Fig. 1) the shrinkage increased to a point which had not been reached during the first air-cured period. Had the specimens continued to dry out, as they undoubtedly would in the laboratory, the shrinkage would and should have attained at least the same maxima at the end of the first air-drying cure as was shown at the end of 80 days. (2) The fluctuations of the data from day to day were almost as great as the differences between the plain and Celite mortars, which would lead to some doubt as to the accuracy of measurements. For instance, on the 46th day (Fig. 1) there was very little difference between the mortars containing Celite in the amounts of 1 to 6 per cent, and yet on the 26th day 3 per cent Celite mortar is shown above the 4 per cent, 5 per cent and 6 per cent mixtures. Again, on the 80th day there is no appreciable difference for 3 per cent, 4 per cent or 5 per cent. In Fig. 2, 5 per cent Celite is shown below the 4 per cent Celite, and, from the 32nd to 44th days, the Celite concrete shows less shrinkage than the plain concrete.

Concrete Mixtures—With reference to the tests on concrete mixtures, we particularly call attention to the fact that the tests actually showed less shrinkage in 1 : 1½ : 3 and 1 : 2 : 4 Celite concrete mixtures than for the corresponding plain concrete mixes. This fact is entirely lost sight of, however, in your sub-title, which merely states, "While Tests Show Concrete Is Less Affected." The sub-title, in all fairness, should have at least stated that in two common concrete mixes referred to the shrinkage was less with Celite.

There are numerous Celite concrete structures of great surface area such as floor and road slabs and thin walls that show relatively less cracking than plain concrete. This reduction in cracking is attributed to the greater uniformity of the Celite concrete.

As a matter of fact, the actual amounts of shrinkage encountered in all of these tests are within the range of experimental error and negligible for all practical purposes. If there was a variation of 13 deg. F. in temperature between readings, the maximum difference in shrinkage of the different specimens, due to temperature, would be more than the maximum difference between Celite and plain concrete mixtures.

Another point which we wish to emphasize is the fact that no consideration is given in this article to the question of improved workability which can be obtained with Celite concrete at a drier consistency than would be used for plain concrete. The tests were all made on concrete having the same slump, whereas in actual practice Celite concrete is ordinarily placed at a lower slump for the same work than would be employed with plain concrete. When Celite is added to a concrete mixture the Celite absorbs a portion of the free water and thus reduces the effective water-cement ratio. It is generally recognized that the shrinkage of concrete is largely dependent on the dryness of mixture when placed. The result is that with the aid of Celite concrete can be satisfactorily placed at a drier consistency than would be possible with plain. A drier concrete will naturally have a higher strength, will be more water-tight and will undoubtedly have less shrinkage.

Summarizing our criticisms of the article by Mr. Levens, we wish to point out that:

1. Only two specimens for each condition were made and no mention is made of the variation between the individual specimens.

2. The type of specimens and exposure conditions do not simulate field conditions.

3. The actual differences in shrinkage are so small that they are of no practical importance even if correct, and, furthermore, are well within the range of experimental error.

4. No reference is made to the relative workabilities of the plain and Celite mixtures, nor to the fact that the Celite concrete could have been placed satisfactorily at a drier consistency than the plain. In the case of the mortar mixture, the point is ignored that a 1 : 3 cement-sand mortar is not considered a practical mortar on account of its harshness and tendency to work "short."

5. The charts show actually less shrinkage of Celite concrete in 1 : 1½ : 3 and 1 : 2 : 4 concrete mixtures than in corresponding plain concrete mixtures, whereas the sub-heading of the article states "Concrete Less Affected."

6. The summary of the author's results as stated in the title and sub-title of the article are not justified by the data presented.

Research work is of value only if its results can be applied in actual practice, and data of the type contained in the article by Mr. Levens are certainly likely to be misleading to many engineers, particularly when they appear in the columns of a paper having the prestige of *Engineering News-Record*.

A. W. KNIGHT,
For Celite Products Company.

New York, N. Y.,
Nov. 6, 1928.

Arizona Views on Compromise on the Colorado River

Sir—Your editorial "Settle Out of Court," p. 339, Sept. 6 issue, is apt to mislead those who are unacquainted with the Colorado River controversy. This question is neither partisan nor political, but economic.

California desires to divert the river out of its natural basin to increase her irrigable land area, to provide for her future growth and the prosperity of her citizens. Arizona desires to retain the water for identical reasons. California is striving through federal assistance to exempt water-power investments from Arizona state and county taxation and to have it subsidize the construction of her irrigation ditches and city water-works. Arizona wants to be able to tax her hydro power the same as other investments in order to maintain and develop the state in which the power is located. The people of each state are advocating the policy which benefits their state or district. The office seekers or politicians of each state naturally espouse the interest of their constitutents.

The issue is not state rights but state existence. No desert state can exist or grow without water. No state or government can exist if unable to secure operating funds by taxation. Resources may not be diverted to enrich one state without automatically impoverishing the state deprived. The question is one of national policy. If one state, with federal help, may take part of the resources of another, it may take them all, if sufficiently powerful politically either individually or by alliance with those with similar interests. The proposed nationalizing of Arizona power would exempt her greatest asset from taxation and greatly reduce her future tax revenues, as the value of her power at usual installation costs would be greater than the value of all the present property in the state.

The Swing-Johnson Boulder dam bill does not constitute a comprehensive plan of river development. It is only a plan for developing California. The Boulder reservoir would be abandoned before the proposed time for federal repayment. Regulation by storage for power purposes is inevitable in the upper portion of the river. When upper storage is provided, Boulder reservoir is ten times as large as will be needed for re-regulation from power to irrigation flow and it is at an unnecessarily long distance from the land to be irrigated. Situated in a latitude and altitude of maximum evaporation, the excessive area of Boulder reservoir would evaporate water which otherwise could irrigate several hundred thousand acres.

Your editorial suggests a compromise. Arizona requested the Governors of Colorado, New Mexico, Utah and Wyoming, together with their irrigation experts, to consider the arguments of Arizona and California. They did so at Denver in the fall of 1927. Both states agreed to the water demands of the five other states in the river basin which will insure their development for the next 150 years. They both finally agreed that New Mexico should be limited to the amount of water she is now using. Either Arizona or California could use all of the remaining water of the river in the next 50 years. California argued to the Governors that she could not take less than two-thirds of the water that reaches Boulder reservoir. Arizona demanded an equal division with California.

The Upper Basin Governors suggested a compromise which split the difference, California to receive 58 per cent and Arizona 42 per cent. A majority of the Arizona commissioners finally agreed to accept this compromise provided California would withdraw the Swing-Johnson bill. California declined to do so.

While the water question was pending Arizona requested the Upper Basin Governors to write a seven-state agreement relating to power. The Governors declined but passed a resolution that the water power should be subject to taxation by the states. The Upper Basin Governors desire their states to retain their own water power but would be glad if Arizona would make power concessions to California in order to secure a seven-state agreement.

Within the last month Arizona wrote the other states seeking to secure a seven-state conference. California replied, asking that the controversy be left to Senators Johnson, Ashurst and Hayden.

California would secure all she desires, should Congress pass the Swing-Johnson bill; any compromise would give her less. So, while expecting her bill to pass, California's objection to a compromise is natural and assured. The pending Swing-Johnson bill has thus precluded a real conference for five years. The defeat of the Swing-Johnson bill will result quickly in a state agreement, as the real needs of flood protection for Imperial Valley will subordinate mere desire for future exclusive and excessive California aggrandisement. Its passage means a long lawsuit. The question is broad. Other states will be drawn into the legal controversy. More than water-power resources will become involved. Some states will be on the "take" side, some on the "keep" side of this question. Each will follow its own interest. Each will justify itself in so doing. All their statesmen or politicians will take part to obtain or save resources.

Should the Supreme Court finally decide such a law valid, California will secure approximately 75 per cent of Colorado River water available for the two states. If Arizona wins, on the theory that the states, not the nation, have sovereignty of water and other natural resources, she can take 75 per cent of the water, as California has right by use to less than a quarter of it, with no complete jurisdiction over a reservoir site for storing and thus obtaining right to more. Because either state might win the large end of a 75-25 division in a lawsuit, Arizona suggested a 50-50 compromise agreement. Arizona offered California in the 50-50 division enough water to irrigate the 420,000 acres the state now irrigates from the Colorado, enough water to provide for the domestic use of 5,000,000 more population in Los Angeles, and in addition enough to irrigate 500,000 new acres.

Any state agreement providing a division of water and power will be a law. It will have to be passed by the legislatures of the states. In Arizona the people have the referendum upon legislative actions.

It is relatively easy to criticise states and their politicians for being selfish. Everybody does so, and perhaps they deserve it; but can you suggest a way to make a sovereign state compromise instead of lobbying for extra-favorable laws in Congress? Do you seriously believe there is a possibility of your suggestion of the seven states "dismissing" or changing their Senators, Congressmen, Governors, water commissioners, attorneys and engineers in order to secure putting their river affairs in the hands of those with "fresh and untrammeled viewpoint" when this entire controversy was started by action being taken before the facts were ascertained and by many articles being written before the writers understood the fundamentals involved?

THOMAS MADDOCK,
Member, Colorado River Commission of Arizona.

Phoenix, Ariz.,
Sept. 14, 1928.

News of the Week

Agreement Reached in Plans for Newark Railroad Station

Negotiations which have been under way for the past four years for extensive railroad, trolley line and street improvements in the city of Newark have culminated in an agreement among the three parties concerned, the city of Newark, the Public Service Corporation and the Pennsylvania Railroad Company. The city's share in the total cost will be about $12,500,000, as will the Pennsylvania Railroad's. The street railway company's contribution will be in the form of an annual rental to be paid for the use of facilities provided by the city. The proposals will be given a public hearing, after which it is expected that the necessary legislation will be passed.

The plans provide for the construction of a new station of the Pennsylvania Railroad, extension of the Hudson & Manhattan tube system, the building of a new high-speed trolley line in the bed of the old Morris Canal, and adjacent street improvements. It will involve the abandonment of the present Manhattan Transfer station and the substitution of the Market St. station as a transfer point for electric and steam engines on the Pennsylvania.

Missouri Approves Table Rock Dam

The application of the Empire District Electric Company for authority to build a dam across the White River at Table Rock, Mo., has been approved by the Public Service Commission of that state and is now before the Federal Power Commission for action. The proposed dam will be 1,924 ft. long and 197 ft. high. The hydro-electric plant is expected to have an annual output of 410,000,000 kw. The dam, which will cost approximately $16,700,000, will be built by the company's own forces. The Empire District Electric Company is controlled by Henry L. Doherty & Company, New York.

Start Work on $40,000,000 New England Power Project

Work is now under way and will be continued throughout the winter on a 250,000-hp. development on two sites along the Connecticut River at Monroe, N. H., and Barnet, Vt., and also at Littleton, N. H., and Waterford, Vt. The work is being done for the New England Power Association by the Connecticut River Power & Development Company, a subsidiary. Construction work so far is confined to the lower of the two dams, where approximately 1,200 men are at work building cofferdams and a 5-mile construction railway connecting with the Canadian Pacific line. It is expected that this railroad will be extended farther up the valley to the upper dam site, making a permanent standard-gage line about 20 miles in length. Work on the upper dam is expected to begin early next summer. Camps are now being built to accommodate 4,000 men, a number which will probably be employed for three years or more.

HUDSON RIVER BRIDGE ANCHORAGE STEEL

Steel grillage totaling 2,200 tons has been placed in the New York anchorage of the Hudson River bridge, a huge concrete block containing 110,000 cu.yd. of concrete, of which more than 50 per cent has already been poured. The picture shows the anchorage grillage in place for the two north cables, with the New York tower in the background. A similar set of grillage steel is in place in the anchorage for the two south cables. On the New Jersey side, preparations are being made to set the anchorage grillage steel in the anchorage tunnels. The two pillow blocks carrying the west end of the stiffening trusses and the splay casting of the cables have been completed, each containing over 2,000 cu.yd. of concrete.

Wanaque Aqueduct Plans Delayed

Minor delays in the preparation and printing of the specifications for the Wanaque aqueduct means that the North Jersey District Water Supply Commission will not be ready to receive bids Dec. 6, as announced in *Engineering News-Record*, Nov. 8, 1928, p. 711. It is expected that plans and specifications will be ready in sufficient time so that bids can be received later in December.

Missouri Pacific Seeks Own Line Into New Orleans

Authority for the construction of a new 82-mile line from Baton Rouge, La., to New Orleans has been requested of the Interstate Commerce Commission by the Missouri Pacific Railway through its subsidiary, the New Orleans, Texas & Mexico. At the present time the Missouri Pacific enters New Orleans from Baton Rouge over the tracks of the Yazoo & Mississippi Valley Railroad under a trackage agreement by the terms of which it cannot participate in any local business between those points. The application states that the construction and operation of the proposed line will, in the opinion of the applicant, result in the construction of a bridge over the Mississippi River near Baton Rouge.

Bids Received for Kill van Kull Bridge Superstructure

Bids for supplying and erecting 26,000 tons of structural steel in the superstructure and approaches of the Kill van Kull arch bridge between Bayonne, N. J., and Port Richmond, Staten Island, were opened Nov. 19 by the Port of New York Authority. Three bids were received, as follows: Bethlehem Steel Company, New York City, $5,331,580; McClintic-Marshall Company, Pittsburgh, $5,469,950; and American Bridge Company, New York City, $5,041,770. The structure will be the longest steel arch span in this country, 1,675 ft. center to center of bearings. The crown of the roadway at the center line of the bridge will be 163 ft. above the water. Completion is expected by 1932.

Dallas to Use Cast-Iron Pipe in Water-Works Extension

By a unanimous vote, the city commission of Dallas, Tex., on Nov. 16 awarded the contract for supplying material for and constructing an extension to the water system of the city to the United States Cast Iron Pipe & Foundry Company, Birmingham, Ala., for $1,264,000. By this action the council ignored the recommendations of the city attorney, the Ulrickson Commission (an advisory body on city expenditures) and F. G. Cunningham, of Fuller & McClintock, consulting engineers on the project. The two latter had favored acceptance of a combined bid totaling $1,211,006 from the same company for material only, and from the Robuck - Humphries Company, Omaha, Neb., for construction of the pipe line. The city attorney, J. J. Collins, advised that an error in the call

for bids invalidated all offers and that the contract should be readvertised.

Water Commissioner S. E. Moss, in explaining the action of the commission, stated that, as the city attorney had ruled a combined award illegal, the commission had but two possible courses: To throw out all bids and readvertise, or to award the contract for the lowest full bid price. The latter alternative, he said, was chosen in order to avoid further loss of time and the risk of higher bids due to increasing prices in the pipe field.

It is expected that a subcontract for laying the pipe will be awarded by the U. S. Cast Iron Pipe & Foundry Company to a local concern, probably the Uvalde Construction Company, which bid $1,177,000 for the entire contract on a steel-pipe basis. This bid, although accepted by the commission early this fall, was vetoed by the Mayor on the ground that the use of steel pipe, under Texas insurance regulations, would increase the fire insurance rates of the city by 5c. per $100. An application to have this differential removed is still under consideration by the Texas State Fire Insurance Board. (See *Engineering News-Record*, Oct. 11, 1928, p. 562, and Nov. 8, 1928, p. 713.)

New Long-Span Bridge to Be Built Near Portland, Ore.

On Nov. 14 the county commissioners of Multnomah County, Oregon, retained Robinson & Steinman, of New York, to determine the exact location for and to select the type of the proposed highway bridge across the Willamette River below Portland, connecting the towns of Linnton and St. Johns. The structure will be known as the St. Johns bridge. The design and supervision of construction are also to be done by this same firm in return for a flat fee covering all its services. This is the structure for which a bond issue of $4,250,000 was authorized at the election last May.

Either the cantilever or the suspension type may be chosen and it is understood that the structure will be a high level bridge with a main span of not less than 1,200 ft. Studies to determine the exact location are expected to take about four months, after which construction is to be begun at once.

Two Engineers Elected Governors

Voters at the recent election not only went to the ranks of the engineers for the chief executive of the country, but also chose engineers as governors of two well-known Eastern states. In Delaware, Clayton Douglass Buck, formerly chief engineer of the State Highway Department and president of the Association of Highway Officials of the North Atlantic States, was selected chief executive. In New Jersey, Morgan F. Larson, civil engineer, state Senator, and at one time city engineer of Perth Amboy, N. J., was the successful gubernatorial candidate.

Drawing Up Financial Plans for Rochester

An appropriation of $25,000 has been made by the Rochester (N. Y.) city council for the purpose of financing the preparation of a plan of capital expenditures covering a term of years. A comprehensive program of major improvements, including a civic center, the extension of Broad St., the development of a harbor at Lake Ontario and other projects is expected to result from this action.

Princeton Dedicates New Engineering Building

With formal ceremonial, Princeton University on Nov. 15 dedicated its Engineering Building, the first independent home of its School of Engineering. Charles Z. Klauder, architect, designed the structure, which is in collegiate Gothic style harmonizing with other recent buildings at Princeton. The new building serves both laboratory and instruction purposes and provides for most of the activities of the School of Engineering, which, since its establishment in 1921, has been housed in various buildings, as were the older civil engineering departments (founded 1875) and the graduate electrical engineering department (1889).

Addresses by Dr. John Grier Hibben, president of the university, and Arthur M. Greene, Jr., dean of the School of Engineering, laid emphasis on the function of the new building, and the institution which it is to house, as a developer of students into both engineers and men. Carlton S. Proctor, president of the Princeton Engineering Association, which had collected a large part of the money required to build the structure, recounted the growth of engineering at Princeton and the aid given to this growth by the association. Augustus Trowbridge, dean of the Graduate School, spoke of the intimate relationship between science and engineering. The rapid growth of the demands of industry upon engineering art was discussed by Dexter S. Kimball, dean of the College of Engineering of Cornell University. Because of these increasing demands, Dean Kimball said, the engineering facts and problems of the future are sure to be far beyond those of today, and the mental preparation of the engineering student accordingly must be sufficiently broad to enable him to think in terms of these future possibilities.

Six Firms Bid on San Gabriel Dam, Near Los Angeles

On Nov. 14 bids were opened by the Los Angeles County Flood-Control District, E. C. Eaton, chief engineer, for the construction of the proposed San Gabriel dam. Six firms submitted bids. Four of the six put in bids on all three propositions—namely, (1) contractor to furnish all aggregate; (2) county to furnish one-half aggregate and contractor the other half; (3) county to furnish all aggregate. Bidders and amounts are given in the accompanying table.

Contractors	Proposal No. 1	Proposal No. 2	Proposal No. 3
MacDonald & Kahn... Claude Fisher..... Chas. W. Ross	$11,250,040	$12,622,590	$12,431,940
Arundel Corp (of Baltimore)	11,974,856	11,784,856	11,594,856
C. J. Bubach & Co.....	12,290,570	11,794,070	11,601,570
Lynn Atkinson..	12,297,390	11,727,390	11,157,390
Guy F. Atkinson and J. F. Shea Co...	12,798,840	12,380,840	(none)
Utah Construction Co. (of Salt Lake).....	13,343,540	(none)	(none)

The bids submitted cover only the actual construction of the dam, including excavation, labor and stipulated materials. The county is to furnish the cement under all of the three propositions, and the cost for materials and other expenses thus far incurred or to be paid later by the county is estimated to total about $11,200,000. Thus present estimates for the total cost of the structure are that it will be at least $22,500,000. In the flood-control bond issue voted April 1, 1924, $25,000,000 was allotted to this project, of which a considerable amount already has been expended.

Award of the contract is expected shortly. Allowing 30 days for arranging bonds, hauling in equipment and establishing camps, it is believed that actual work should begin by the first of the year.

NEW ENGINEERING BUILDING OF PRINCETON UNIVERSITY

New York Water Tunnel Suit: A Correction

A typographical error in last week's news report on the court decision rendered in answer to a suit by the Del Balso Construction Company against the city on the New York water tunnel contract award was made in the explanation of the low bid. The first paragraph at the top of the first column of page 750 should have read as follows:

> The lowest possible combination of bids was as follows: section 224, Carleton, $10,585,630; section 225, Del Balso, $10,629,889; sections 226 and 227, McGovern, $21,462,675, a total of $42,678,194 for the entire tunnel, or $14,373.50 under the McGovern company's bid for four sections.

The report last week read "$14,373.50 over the McGovern company's bid for four sections."

Engineers to Honor Engineering Congress Official

A dinner in honor of Dr. Masawo Kamo, professor of mechanical engineering at Tokyo Imperial University and chairman of the organizing committee of the World Engineering Congress, is to be given at the Engineers Club in New York on Nov. 26 by the American committee of the World Engineering Congress and the New York sections of the four founder societies. The World Engineering Congress is to be held in Japan next summer. Dr. Kamo is on his way back to Japan after an extended visit to Europe in the interests of the congress and of the World Power Conference, which is to be held in Tokyo simultaneously with the engineering congress.

Preliminary Plans Announced for A.C.I. Convention

Announcement of the general program for its annual convention at Detroit, Mich., Feb. 12-14, has been made by the American Concrete Institute. The first session, on the afternoon of Feb. 12, will be devoted to several papers under the one general theme, "A Condition Survey of Concrete Structures." Structures of many different kinds and types under a variety of conditions will be considered in this symposium. The second session, during the evening of the same day, will include several papers descriptive of important uses of concrete in large undertakings in Detroit and vicinity, including a paper on the land tunnel work of the Detroit Board of Water Supply, by L. G. Lenhardt.

On the second day there will be concurrent sessions in both the afternoon and evening. The subjects to be covered will include research, concrete stone and ornamental work, concrete building units of block, brick and tile, and concrete specifications. Both morning and afternoon of the third day, Feb. 14, will be devoted to a symposium of about ten papers from as many authorities setting forth the special characteristics required in concrete for different uses and exposures. The meetings will end with the annual dinner, at which two medals will be awarded—the Leonard C. Wason medal for the most meritorious paper presented at the 1928 convention in Philadelphia, and the Henry C. Turner medal for "the most notable achievement in the field of concrete."

Mulholland Retires After 50-Year Service at Los Angeles

On Nov. 14 William Mulholland, chief engineer and general manager, Los Angeles bureau of water works and supply, tendered his resignation, to be effective Dec. 1. Being now 73 years of age, he said, in presenting his resignation to the board of water and power commissioners, he desires to rest and to leave duties of his position to younger men of the organization. Mr. Mulholland entered the employ of the City Water Company, the privately owned company then serving Los Angeles, in September, 1878. In 1886 he was made chief engineer and superintendent and he was still in this position when the private company was bought by the city in 1902. Thus for more than 40 years there has been no interruption to his service as head of this water system.

In 1904 Mr. Mulholland began surveys which led to decision to build the 250-mile Owens River aqueduct. He estimated the cost of this project, including necessary rights-of-way, at $24,500,000. When the aqueduct was completed and the first Owens River water was delivered to Los Angeles in 1908 the cost totaled as slightly less than his original estimate.

During the years that Mr. Mulholland has been the responsible head of the Los Angeles water system it has been developed from a property worth about $100,000 to the present system, the value of which is estimated at $100,000,000. City distribution mains and laterals now total about 3,200 miles in length and serve a population of approximately 1,300,000 people.

Since 1923 there has been carried on under Mr. Mulholland's direction an exhaustive study of the proposal to bring an additional water supply to southern California cities from the Colorado River. In this work topographical data have been secured on 18,000 square miles of desert and mountain country never before surveyed. In its ultimate form the proposed Colorado River aqueduct would supply the domestic water needs of 7,500,000 people in addition to the 2,000,000 which it is expected can be supplied ultimately from Owens River.

In accepting Mr. Mulholland's resignation the board indicated that it was desirous of effecting some arrangement whereby he can be retained as consultant so that his valuable experience will continue to be available.

Port Officials Hold Convention in Texas

The annual convention of the American Association of Port Authorities met at Houston, Tex., Nov. 12-14, and on Nov. 15 moved to Galveston in order to inspect the port facilities at that point. During the convention committee reports were received on the subjects of technical port language, Canadian port legislation for 1928 and oil pollution in harbors. Papers were presented as follows: "General Principles of Design and Location of Ports," by Rufus W. Putnam, Chicago; "A Study of Labor Productivity and of Harbor Industrial Equipment in the Principal Ports of the United States," Dr. Boris Stern, U. S. Bureau of Labor Statistics; "The Port Terminal Railroad," by Col. B. C. Allin; "The Dredging of a Modern Port," by James H. Polhemus, general manager, port of Portland, Ore.; "Promoting a Port," by H. J. Luhn, port director, Lake Charles, La.

New Missouri River Bridge Begun

Steel is now being fabricated for and erection work will start on Dec. 1 on a new bridge across the Missouri River at Hermann, Mo., which will be the only highway crossing in a 100-mile stretch of the river. The contract for 1,800 tons of steel has been let to the Kansas City Structural Steel Company, which is also in charge of the erection. The date of completion specified is Aug. 1, 1929. The J. G. White Engineering Corporation, New York City, is engineering counsel for the bridge company, and Sverdrup & Parcel, St. Louis, Mo., are supervising the work. The new structure will be operated as a toll bridge.

Mexican Railway Contract Awarded

Grading of 21 miles of roadbed and the construction of 28 bridges and culverts are involved in a contract recently awarded C. E. Crowley, Los Angeles, Calif., for railway construction in the states of Sonora and Baja California, Mexico. The crossing of the Colorado River delta alone will involve excavation of 550,000 cu.yd. of earth and the construction of nearly 2 miles of trestles.

California to Build Fokker Planes in $4,000,000 Plant

Ground is to be broken this month in southern California for a new airplane factory estimated to cost about $4,000,000, which will produce 3,000 airplanes annually, according to announcement of officials of the company in San Francisco. It is stated that contracts for construction have already been awarded and that the new factory will be in service by March 1, 1929. The program of the new manufacturing organization calls for the production of Fokker type planes to which, it is announced, this

company has obtained exclusive American rights. A considerable part of the output of the new plant will be absorbed by two operating companies prominent in the financing of the plant, the Universal Aviation Corporation of Chicago and the Western Air Express, which at present maintain daily flying schedules of 7,000 and 3,700 air-miles, respectively.

Moffat Pioneer Tunnel Leased for Denver Water Supply

The city of Denver has signed the final contract which gives it possession of the pioneer bore of the Moffat tunnel for a term of five years. The specified rental is $1 a year, and the city assumes responsibility for maintenance. Through the leasing of the tunnel, Denver expects to perfect rights to water on the western slope of the Rocky Mountains which will be needed for domestic consumption in the near future. A total supply of 100,000 acre-ft. will be available when needed. It is expected that before the expiration of the five-year lease the city will start lining the tunnel with concrete in order to make it suitable for carrying water.

Payment Made on Salt River Irrigation Project

The Salt River Valley Water Users' Association, operating the Salt River federal irrigation project in Arizona, recently tendered to the government a payment of $634,085.58 in payment of construction charges due Dec. 1, 1927, including interest at 5 per cent on the deferred payment amounting to $30,403.98. An additional payment was made in July of $515,699.52, and another of $609,961.32 is due Dec. 1 of this year. The association has repaid $4,676,000 of its total debt to the government of $10,166,000. That the project is amply able to meet the charges is indicated by the fact that crops grown in 1927 amounted to more than $21,000,000 in value, or $97.50 per acre. The total value of crops grown on this project in one year is almost equal to the entire construction cost.

Ohio Mechanics Institute Celebrates Centennial

The completion of 100 years of technical education was celebrated by the Ohio Mechanics Institute, Cincinnati, Ohio, Nov. 22-24. The institute is believed to be the first technical school in the Middle West to achieve its 100th anniversary. Included in the three-day celebration was an open house to which the public was invited. All lecture rooms, studios, laboratories and shops were in operation, with students in their regular places. An active part in the celebration was taken by the alumni association. Addresses were made by Murray Seasongood, Mayor of Cincinnati, and Dexter S. Kimball, president of the Society for the Promotion of Engineering Education.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Qualification of Bidders on Government Work—Washington Awaits Report on Boulder Dam

IN A RULING issued in connection with the federal government's extensive building program in Washington, the Comptroller General explains the procedure that government agencies may follow in the determination of what constitutes a responsible bidder. According to this ruling, instead of allowing only those who can properly qualify to bid, the government should exercise its discretionary power in rejecting the bids of parties not believed to be competent to perform the work. Prequalification, the Comptroller General believes, not only would deny equal opportunity to bidders for government contracts but would tend also to encourage collusive combinations of bidders in restraint of competition.

Regarding the rejection of bids because of the lack of qualification of the bidders, this ruling makes it clear that past performance is not the ultimate test. It is pointed out also that the necessary financial standing of a prospective contractor with the United States should only be such as to enable him to finance the difference between the cost of the work and the payments made by the government of 90 per cent of the contract price in monthly installments.

Foreign Construction

A foreign construction news service has been started by the industrial machinery division of the Commerce Department. This consists in free distribution of a weekly release, about seventeen mimeographed pages, to firms desiring the information. Excerpts from the same material are published under the heading of "Construction News" in the monthly *Commerce Reports* as formerly.

To Protect Fishing Interests

Preliminary steps are being taken to establish the rights of fishing interests about the Bay of Fundy against possible losses which may be caused by the Passamaquoddy Bay power development. The present productiveness of the fisheries in this region above that of the surrounding coast is apparently "due to a combination of factors that have produced a water-mixing machine of gigantic proportions," according to Dr. A. G. Huntsman, of the Biological Board of Canada, an authority on oceanographic conditions, as quoted in a bulletin of the U. S. Bureau of Fisheries. Dr. Huntsman maintains that the ebbing and flowing twice a day of tides ranging from 20 to 25 ft. draws water of high salinity from the ocean depths which is mixed with surface waters when vast volumes boil in and out of the narrow entrances to the bay. This furnishes important salts and an evenness of temperature favorable to the growth of organisms on which the fish feed. Completion of the power project will unquestionably limit this mixing effect. After careful study Dr. Huntsman predicts that the production of herring, sardines, pollock, haddock, cod and clams will be greatly reduced, thus injuring fisheries in both the United States and Canada and the canning and packing interests in Eastport, Me., one of the state's largest industries.

The problem was discussed at a meeting of the North American Commission on Fishery Investigations, made up of delegates from several countries, in Toronto Oct. 22. A committee was appointed to co-operate with the power and fishing interests and to report on the probable effect of the development. It is expected that the report will be forthcoming within the next few weeks.

Boulder Dam Report

Members of Congress returning to Washington expect the outcome of Boulder dam legislation to depend on the report which will be made by the Sibert commission. If that commission reaches the conclusion that the project is feasible from an engineering standpoint there is little doubt that the Swing-Johnson bill will be passed. Not only do these returning legislators expect a favorable report to win the votes of many of those who have been against the project but they also bring word that the utilities themselves are taking much the same view of the situation.

While it is known that one member of the engineering commission is contending that the commission cannot reach an intelligent conclusion in the time allotted, there also are assurances that the other members of the commission are insistent upon complying with the instructions of Congress in submitting the best report that they can on Dec. 3. To do otherwise, it is argued on Capitol Hill, would be equivalent to direct aid to the opponents of the bill. The Boulder dam measure is the unfinished business and will be the first regular business taken up when Congress convenes. The failure to receive the engineering report might allow the bill to be displaced in time to be lost, which would be a valuable asset to the opponents of the bill in a short session of Congress.

In that connection it is pointed out that the commission does not have to make recommendations at this time covering the details of the type of structure which can be built under conditions as they exist in the canyon. Under the interpretation placed on the resolution authorizing the commission, it will continue in existence after the submission of its first report. If the first report states conclusively whether or not the project is reasonably feasible and gives the major reasons for that finding, the commission then can develop the details of the structure which it thinks can be built successfully under the physical limitations existing.

Engineering Societies

CALENDAR

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 14-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; annual meeting, New York, N. Y., Jan. 16-18.

THE SOCIETY OF TERMINAL ENGINEERS has elected Victor Gelineau president for the year 1929 to succeed Harold M. Lewis. Mr. Gelineau is chief engineer of the New Jersey Board of Commerce and Navigation. Vice-presidents elected for the year are Lewis Gwyn, Charles W. Bryan, Jr., Roy S. MacElwee, George W. Osgood and Frederic H. Fay. At the regular meeting of the society held in New York on Nov. 13, Robert Farnham, chief engineer, Philadelphia Improvements, Pennsylvania Railroad, spoke upon the terminal work of his company in that city, which is now well under way.

THE MILWAUKEE ENGINEERS SOCIETY has elected as president Hans Dahlstrand, engineer in charge of the steam turbine department of the Allis Chalmers Manufacturing Company. Other officers for 1928-29 include William E. Crawford, vice-president, and H. W. Rohde, secretary.

THE BOSTON SOCIETY OF CIVIL ENGINEERS, Highway Section, at its Nov. 27 meeting will hear H. C. Holden, district engineer of the Massachusetts Highway Department, speak on "The Hot Mix Type of Highway Surfacing."

THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS will meet at Chicago, Ill., Dec. 4-7. Raymond Olney, St. Joseph, Mich., is secretary.

THE WEST VIRGINIA ROAD BUILDERS ASSOCIATION will hold its annual meeting at Huntington, W. Va., Dec. 10-12, 1928. The secretary is Howard A. Levering, 500 Robson-Prichard Building, Huntington, W. Va.

THE SOUTH CENTRAL DIVISION of the National Highway Traffic Association has announced its program for the meeting to be held Dec. 3 at New Orleans, La., in conjunction with the Asphalt Paving Conference. The presiding officer will be R. Keith Compton, honorary vice-president of the association and president of the American Road Builders Association. Papers to be presented are as follows: "The Traffic Control Program of New Orleans," by Bryson Vallas, city engineer, New Orleans; "The High Cost to Highway Transport of Bottlenecks," by George E. Hamlin, chief engineer of maintenance, Connecticut State Highway Commission; "Highway Traffic Control in Montreal," by J. E. Blanchard, chief engineer of the road department of Montreal; "The Traffic Control Problem From the Viewpoint of the Man of the Street," by Harold B. Pullar, secretary, James B. Berry's Sons Company, Chicago; and "One Hundred Cents for the American Highway Dollar," by Arthur H. Blanchard, consulting engineer, National Highways Association.

Personal Notes

Major FRANCIS K. NEWCOMER, Corps of Engineers, has been relieved from duty as an instructor at the Engineers School, Fort Humphreys, Va., and ordered to Washington for duty as assistant chief engineer of the Federal Power Commission.

A. W. KOEHLER has been appointed secretary of the National Conference on Street and Highway Safety. Mr. Koehler has been engaged in safety work since his graduation from Purdue University in 1916, and has lately been in charge of accident prevention work of the street-railway systems of Rochester, N. Y., and Milwaukee, Wis.

W. L. THOMPSON, Starkville, Miss., has just completed an engagement in British India for which he left this country in June, 1925. His principal work in the East was in Burma, where he was in charge of the construction of a river training wall and reclamation project on the Irrawaddy River for the Indo-Burma Petroleum Company. From 1913 until 1922 Mr. Thompson served as chief engineer of the Mississippi Levee District (State of Mississippi) and during that time did much toward the development of the type of cableway machine now extensively used in levee construction on the Mississippi River.

G. E. DEATHERAGE is assistant general superintendent of construction on the new $10,000,000 plant being built for the American Enka Corporation at Asheville, N. C., by the H. K. Ferguson Company of Cleveland. Mr. Deatherage has been for the past three years in Huntington, W. Va., as superintendent in charge of several construction projects.

EVERITT W. WILSON, who recently resigned as vice-president of R. W. Hebard & Company, Inc., has become associated with the J. G. White Engineering Corporation and will sail from New York on the S.S. "Ebro" Nov. 29 for South America.

ALONZO J. HAMMOND, for the last five years engaged in construction work for the Mellon-Stuart Company and James O. Heyworth, Inc., has opened an office for general engineering practice at 120 South La Salle St., Chicago. He proposes to handle the engineering of bridges, railway terminals, hydro-electric plants, buildings and examination of properties for financing. Mr. Hammond made the original layouts and plans for the Chicago Union Station and became assistant chief engineer during its construction. Previous to that work he was engineer of bridges and harbor for the city of Chicago. He is a director of the American Society of Civil Engineers and official nominee from Zone III for vice-president.

JOHN EVANS, county engineer of King County, Seattle, Wash., was elected county commissioner at the Nov. 6 election.

Col. E. N. JOHNSTON, formerly of the U. S. Army Engineers and recently chief engineer of the Port division of Fox Brothers International Corporation, has been appointed chief engineer of all activities of the company. He will make his headquarters in Paris, France, where he will supervise engineering and construction contracts of the company in France, Spain, Turkey, England, Syria and Argentina.

Obituary

Dr. ALEXANDER ZIWET, for 37 years a member of the faculty of the University of Michigan, died in Ann Arbor, Mich., on Nov. 18, at the age of 61. Prior to his retirement in 1925 he was head of the engineering and mathematics department.

GEORGE ALBERT NOSKA, of the firm of Lang & Noska, consulting engineers, New York City, died at Hastings, N. Y., Nov. 12 at the age of 54. Throughout his life he had been intimately connected with the design and construction of office buildings in Philadelphia and New York City. He was a member of the American Society of Civil Engineers and a veteran of both the Spanish-American and World wars. In the latter he served as a captain with the 303rd Engineers, 78th Division, being discharged with the rank of major in the Engineers Reserve Corps.

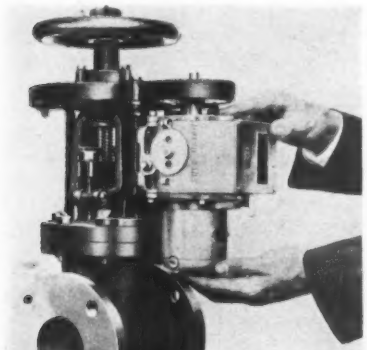
SIDNEY JOHNSTON JENNINGS, mining engineer, died suddenly in New York City on Nov. 17, aged 65. After his graduation from Harvard with the degree of civil engineering, he was employed by mining companies in this country, but a large part of his life was spent abroad, in the diamond and gold mines of South Africa. During the World War, Mr. Jennings was president of the American Institute of Mining Engineers.

PATRICK J. MALLEY, civil engineer in the Department of Public Works, Boston, Mass., for 38 years, died Nov. 14 following an illness of over a year. He was 61 years old. Mr. Malley received his first appointment in the city service in June, 1889, and since that time had been engaged in many municipal undertakings for the city of Boston. In 1913 he was appointed engineering adviser to the Mayor. He was a member of the American Society of Civil Engineers.

Construction Equipment and Materials

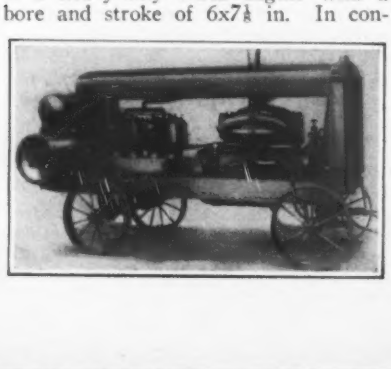
Electric Motor for Operating Small Valves

Power operation of valves up to 6 in. diameter is made possible by a new motor-driven valve-operating unit similar in principle to standard units of larger sizes which have long been in use. This mechanism may be operated automatically by means of float switches, temperature-controlling devices, pressure regulators and similar controlling mediums, or it may be manually operated by push-button control. It is designed primarily for valve-operating service in industrial plants where regulations of pressures and temperatures is necessary, but it may be easily adapted to many miscellaneous applications. The unit is being manufactured by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.



Air Compressor Built in Larger Size

Adding a larger unit to the line of compressors now being manufactured, Schramm, Inc., West Chester, Pa., is now building a machine of 360-cu.ft. capacity for both portable and stationary installation. The compressor itself is of the four-cylinder vertical type with a bore and stroke of 7⅛x5 in. and a displacement of 360 cu.ft. per minute when operated at 780 r.p.m. The power unit is a heavy-duty Buda engine with a bore and stroke of 6x7⅛ in. In construction the new machine conforms to the pattern of the rest of the Schramm line and includes all the features regularly found in their compressors, including air and gasoline strainers, automatic governor and a clutch to enable the operator to start the engine independently of the compressor.



Machine Cleans Dirt From Pavement Cracks

Officials charged with highway and street maintenance will be interested in a new machine developed for the city of Lansing, Mich., for the purpose of cleaning dirt from cracks in the pavement preliminary to patching with tar or similar material. This outfit was designed and built for the city by the Novo Engine Company, of Lansing, and has proved so satisfactory that the company is placing it on sale for general use.

The machine consists of a Novo 2-hp., single-cylinder, hopper-cooled, roller-bearing engine direct connected through two to one gearing to a Connersville blower. The complete outfit is mounted on a channel frame truck with welded tubular spreaders, for easy transportation. The blower has a discharge of 35 cu.ft. per minute and is connected through a rubber hose to an ordinary garden spray nozzle. It is stated that one workman with this outfit can obtain better results than two with brooms.

New Bituminous Lining for Steel Pipe

American rights to a patented process for applying a bituminous type lining to steel pipe have been acquired by the National Tube Company, Pittsburgh, Pa., which is now marketing the pipe in this country. Talbot lined pipe is the result of many years of research and extensive experiments carried out in England to develop a practical means of preventing corrosion and to minimize loss of capacity due to internal incrustation or tuberculation. The lining consists of a molten bitumen, specially treated to give proper physical properties, mixed with a chemically inert filler ground fine. This is applied to the inside of the pipe by the centrifugal process. The surface resulting is very smooth, with a glossy, mirror-like finish. The lining is tough, elastic and impervious to water. It does not react with water in any way and leaves no taste. Furthermore, it is claimed that the lining is not attacked by well-known acids up to at least 33 per cent concentration.

Pipe lined with this material can be furnished with any of the customary forms of exterior protection, and is available in sizes from 4 in. upward. The lining has a minimum thickness of ¼ in. on all sizes. Lengths available and type of couplers used are in accordance with conventional practice.

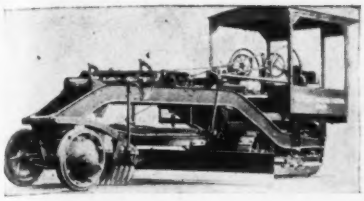
Hydraulic Hoist Operates Three-Way Body

A line of electrically welded steel truck bodies dumping to either side or to the rear and operated by a hydraulic hoist is now being produced by the Commercial Shearing & Stamping Company, Youngstown, Ohio. These are made with capacities varying from 1½ to 15 tons and may be used with standard makes of motor trucks and tractors. When dumping to the rear, the body angle varies from 45 to 70 deg.; to the side, from 47 to 55 deg. The rear gate is double acting, while the side gates swing out from the top so that the load is deposited clear of the rear wheels.

The hoist, which is available separately if desired, consists of two telescoping cylinders with ringless pistons. It is attached to the chassis frame clear of the drive shaft and is designed to provide the necessary flexibility under unusual dumping conditions.

Tractor-Driven Motor Patrol

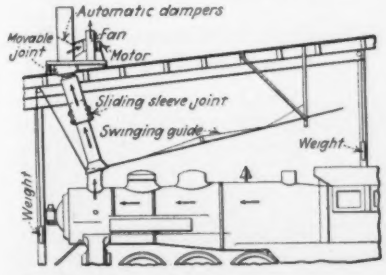
Designed especially for use with the Caterpillar Model 20 tractor, a new motor patrol is now in production at the plant of the Russell Grader Manufacturing Company, Minneapolis, Minn. This machine, known as the Russell Motor Patrol No. 6, is of the same general pattern as the other types of motor patrols made by this company. The blade is supported by a large 58-in. circle reinforced with an extra angle iron, and provided with a clamp to set the blade. The blade side shift is of the rack and pinion type, operated by a worm and gear inclosed in a metal housing. The blade lift is also operated by worm and gear. Timken bearings are used in the front wheels. The grader unit is pivoted centrally to the tractor, with stops in front and rear



to prevent excess motion. A metal cab is provided which may be entirely inclosed and covers the spring-mounted operator's platform. The entire unit weighs 8,850 lb. with scarifier and has a wheelbase of 210 in. A snow plow attachment is available for winter use.

Automatic Smoke Eliminator Unit for Roundhouses

Adoption of a new smoke eliminator unit in the Great Northern Railway's new engine house at Grand Forks, N. D., has resulted from a two-year test of the device in the company's roundhouse at Minneapolis Junction. The apparatus, known as the Drafto unit, is manufactured by the Locomotive Forced Draft Company, of Minneapolis, Minn., and is now being marketed commercially. The device replaces the smokestack in the engine house roof and does away with the steam blower line that is attached to the locomotive to provide the draft necessary to fire up the engine. In addition, it is used to cool off the firebox after the fire is dumped, speeding up repair and inspection work. The eliminator consists of a swinging telescopic pipe or barrel which drops down over the smokestack, a suspended movable frame which guides the barrel into position and an electric fan. As a locomotive enters the round-



house the smokestack strikes the suspended guide. As the engine moves forward, the pipe is pressed upward, a telescopic joint and a flexible ball joint allowing sufficient play for this motion. As the stack reaches the end of the guide, the barrel or pipe drops over the smokestack, affording a direct exit for gases to the open air. The device provides for a variation of 3½ ft. in the height of smokestacks, and allows for a 6-ft. zone in which engines may be spotted. A motor-driven fan in the section above the roof draws the smoke and gases and provides forced draft for firing up the engine. A damper is provided which closes when the engine leaves the pit, thus conserving heat in the engine house.

Manufacturers and Trade Associations

CALENDAR

ANNUAL MEETINGS

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 9-11, 1929.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 14-18, 1929.

NATIONAL CRUSHED STONE ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 21-24, 1929.

Business Notes

PENNSYLVANIA-DIXIE CEMENT CORPORATION, New York City, announces the appointment of J. H. Chubb as manager of its service bureau, with headquarters at the New York office. Mr. Chubb is a member of the Western Society of Engineers, the American Concrete Institute and the American Society for Testing Materials. For many years he has been a member of the committee on technical problems of the Portland Cement Association. He is also the author of a number of booklets covering the proper use of concrete.

TIMKEN ROLLER BEARING COMPANY, Canton, Ohio, has put into effect an expansion program involving the expenditure of about $6,000,000 for additions to both steel mill and bearing factory, and also the purchase of the plant and equipment of the Weldless Tube Company at Wooster, Ohio.

TAFT-PEIRCE MANUFACTURING COMPANY, Woonsocket, R. I., announces the appointment of Frederick S. Blackall, Jr., as general manager to succeed his father, the late Frederick S. Blackall. He is also assistant secretary of the company.

JOSEPH T. RYERSON & SON, Inc., Chicago, Ill., will henceforth handle the Millers Falls brand of portable electric tools.

PENNSYLVANIA PUMP & COMPRESSOR COMPANY, Easton, Pa., has appointed J. F. Rodgers, Pittsburgh, Pa., and Gustavo Preston, Boston, Mass., its distributors in the territory named.

FAIRBANKS, MORSE & COMPANY, Chicago, Ill., has advanced John A. Manley, formerly manager of sales development, to the post of vice-president in charge of sales.

RYAN MANUFACTURING CORPORATION, Chicago, Ill., and C. D. EDWARDS MANUFACTURING COMPANY, Albert Lea, Minn., have consolidated their sales organizations, effective Nov. 1. It is understood that this is anticipating the eventual consolidation of manufacturing and other activities of the two companies. Roger D. Edwards, heretofore secretary and treasurer of the Edwards company, has been elected a vice-president of that company and also of the Ryan company. He will direct the sales activities of the two corporations.

New Publications

Air Compressors and Engines—CHICAGO PNEUMATIC TOOL COMPANY, New York, N. Y., has issued new and revised sectional catalogs describing the products of the company. Bulletins Nos. 700, 720 and 773 are new editions of previous publications describing duplex air compressors, steam- and power-driven air and gas compressors, and semi-Diesel oil engines, respectively. Bulletins Nos. 786, 787 and 788 are first editions devoted to vertical duplex compressors, electric motor-driven portable compressors and vertical Simplex air compressors.

Waterwheels — PELTON WATER WHEEL COMPANY, San Francisco, Calif., builds a series of standardized water motors of small size which are described in a recent bulletin No. 26. The standardized wheels are of a size to be economically used by the individual land owner, isolated industry or a small community.

Industrial Heating Units—B. F. STURTEVANT COMPANY, Boston, Mass., describes the Sturtevant Tempervane heater in Catalog No. 363. This book gives many pages of charts and tables of value in designing ventilating and heating equipment for industrial buildings.

Piping—ROSS HEATER & MANUFACTURING COMPAY, INC., Buffalo, N. Y., has issued a new catalog covering all products of the company. Of particular interest to civil engineers are the expansion joints manufactured by the company for use in building services and steam lines.

Electric Motors—LOUIS ALLIS COMPANY, Milwaukee, Wis., has published bulletin 507, supplementing bulletin 505, which illustrates several of the many special types of motors produced by the company for particular purposes and industries.

Asphalt Paving—THE ASPHALT ASSOCIATION, New York City, has taken the rebuilding of old pavements as the theme of a 32-p. illustrated book entitled "Old Pavements Made New." The text and illustrations describe typical instances of resurfacing from cities and towns in all parts of the United States.

Trailers—ROGERS BROTHERS CORPORATION, Albion, Pa., devotes a 32-p. illustrated catalog to describing all models of trailers and semi-trailers built by the company. Many illustrations are given showing the trailers in use under difficult conditions.

The Business Side of Construction

Over 5 Per Cent of Total Exports Are Construction Materials

American products are playing an increasingly large part in the general construction activities of foreign countries. Last year construction materials to the value of $238,848,000 were exported from the United States, as against materials valued at $181,682,000 exported in 1926, or an increase of 32 per cent. General construction in this country is also calling for large quantities of foreign products, but to a decreasing degree. Last year construction materials valued at $139,416,000 were imported, as against $156,174,000 in 1926, or a decrease of 10.7 per cent. The exportation of construction materials has been on the increase ever since the end of the war. As foreign nations reach a higher and higher state of economic stability they are increasing their general construction operations, calling for more and more American materials.

The leading importers of American construction materials are Japan, Australia, the United Kingdom and Canada, about in the order named. The export figures issued by the Bureau of Foreign and Domestic Commerce do not permit of an accurate figure on this item, but these four nations easily lead in the more important items.

Almost one-half of the construction materials exported are sawmill products, and almost one-half of the imports are also sawmill products. The exported wood products consist largely of soft woods, while the imported material includes a large proportion of hardwood.

Pipe of various kinds is the second largest item in the export list of construction materials. A very large proportion of this material goes to Venezuela for use as casing and oil-line construction. Japan takes almost one-fifth of the welded black pipe exported.

The exportation of construction and conveying machinery reached a total of $19,125,849 in 1927. Of this amount excavators accounted for $4,841,962, road-making equipment $2,218,076, excavator parts and accessories $1,782,233 and concrete mixers $1,130,606. No construction or conveying machinery was imported in the past two years.

E. N.-R. Index Numbers

	Cost			Volume	
Nov. 1,	**1928**	**209.46**	**October,**	**1928**	**363**
Oct. 1,	1928	207.71	September,	1928	296
Nov. 1,	1927	201.98	October,	1927	269
Average,	1927	206.24	Average,	1927	263
Average,	1926	208.03	Average,	1926	228
1913		100.00	1913		100

Drop in Volume of State and Municipal Construction

That the volume of new construction under state and municipal projects during the current year is on a slightly lower plane than last year is indicated from sales of state and municipal bonds. The sales of such bonds total $1,096,086,653 for the first ten months of the year, or about $150,000,000 below last year's record. Compilations by the *Daily Bond Buyer* of New York indicate that this is the smallest volume of state and municipal bond sales for a corresponding period since 1923. For the month of October new issues show an increase over July, August and September, but a sharp reduction from the October, 1927, total. In order to equal the final figure for the entire year 1927, new issues during the last two months of this year would have to aggregate about $380,000,000. Data now in hand indicate that actual sales will not exceed half that amount.

The following table shows for the past ten years the volume of state and municipal bond flotations for the first ten months of each year:

1919..	$634,775,848	1924..	$1,252,844,752
1920..	627,494,610	1925..	1,166,906,834
1921..	948,135,416	1926..	1,143,065,173
1922..	1,132,455,766	1927..	1,254,799,586
1923..	905,653,096	1928..	1,096,086,653

Washington Leads in Cost of Dwellings

Data just issued by the U. S. Bureau of Labor Statistics indicate that the average cost of one-family dwellings in fourteen cities of the United States during the first half of 1928 as stated in the permits was $5,169. The most costly single dwellings were built in the city of Washington, as $8,534 per dwelling was spent in the capital city for the erection of this type of dwelling. In St. Louis permits were issued for 934 one-family dwellings and their average cost was only $3,619. The average cost in Baltimore was $4,001.

Multi-family dwellings provided for 93,368 families in these fourteen cities. They care for more than three times as many families as were provided for in one-family dwellings. The average cost per family of the multi-family dwellings was $4,214. The average cost per family for this class of structure ranges from $2,063 in St. Louis to $7,014 in the Borough of Manhattan. The average cost of two-family dwellings was $4,356, and 14,312 families were provided for in this class of dwelling.

Construction Contracts 10 Per Cent Over Last Year

Construction contracts let during the week ended Nov. 20 reached a volume about 10 per cent greater than that during the same week last year. For industrial buildings they were about 50 per cent under last year, but for commercial buildings were 28 per cent higher. The accumulated total for the year exceeds that of last year by 16 per cent.

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Nov. 20, with some comparisons, total as follows:

(In Thousands of Dollars)

	Nov. 20, 1928	Nov. 13, 1928	Nov. 22, 1927
Buildings:			
Industrial	$4,733	$5,905	$9,280
Commercial	34,094	31,334	26,626
Streets and roads	5,978	10,872	7,160
Other construction	9,574	60,833	6,149
Total	$54,379	$108,944	$49,215
Total, all classes, Jan. 1 to Nov. 20:			
1928			$3,322,788
1927			2,875,922

EXPORTS AND IMPORTS OF CONSTRUCTION MATERIALS

Values given in thousands of dollars

	Exports		Imports	
	1926	1927	1926	1927
Marble in blocks	$252	$237	$1,792	$2,531
Roofing slate	53	80	.....	.....
Other building stone	1,459	1,857	981	874
Sand and gravel	610	558	342	303
Cement, portland and other hydraulic	2,996	2,797	5,125	2,956
Glass, window and plate	427	465	12,591	7,896
Lime	192	211	358	366
Fireclay	348	392	.....	.....
Gypsum and plaster	797	471	1,488	1,391
Electrical porcelain	1,541	1,101	.....	.....
Earthenware plumbing fixtures	1,027	1,199	.....	.....
Fireclay brick	708	874	303	138
Building brick and hollow tiles	177	161	.....	.....
Wall and floor tiles	376	391	1,069	1,077
Asbestos	2,685	1,918	9,313	10,327
Asphalt and bituminum	1,883	2,283	1,045	1,140
Wood, unmanufactured	11,078	12,525	16,883	17,896
Wood, sawmill products	97,444	107,629	74,579	64,004
Doors	3,350	3,729	.....	.....
Sash, blinds, trimming and moldings	350	387	.....	.....
Hardwood flooring	484	653	.....	232
Laths and shingles	457	467	.....	.....
Structural iron and steel	15,336	13,239	3,923	5,532
Railroad track	7,643	6,795	1,149	423
Pipe, miscellaneous	24,317	21,578	5,612	7,261
Pipe fittings	7,528	6,529	.....	.....
Nails	986	865	348	394
Bolts, nuts, etc	2,409	2,196	.....	.....
Tools	16,959	16,481	614	731
Hardware	8,825	7,820	.....	.....
Construction and conveying machinery	17,047	19,125	.....	.....
Roofing preparations	366	411	.....	.....
Roofing, asphalt and asbestos	2,066	1,945	.....	.....
Total for all construction materials	$181,682	$238,848	$156,174	$139,416
Totals of all exports and imports	$4,711,721	$4,758,314	$4,430,888	$4,184,378